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MAY 1956

THE SCIENCE TEACHER

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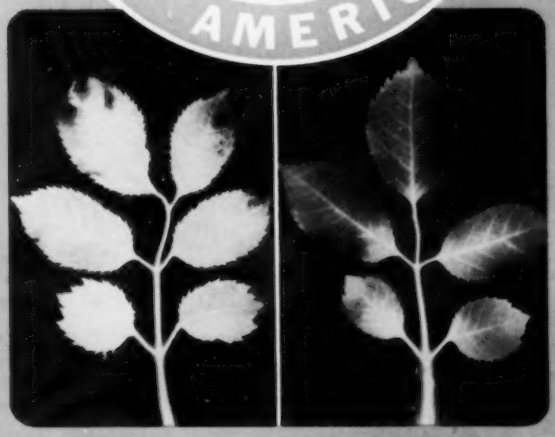

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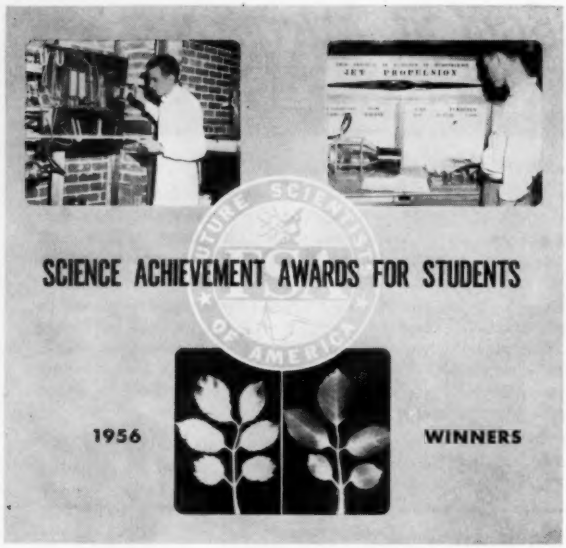

THIS MONTH'S COVER . . . shows how three of the entrants in the1956 program of Science Achievement Awards for Students used photographs to illustrate their winning entries. *Upper left*—The original piece of apparatus constructed by Robert Armsby (Region III; Grades 11-12) to measure food oxidation in the albino rat. *Upper right*—A turbojet engine designed and constructed by Kenneth Johnston (Region IV; Grades 11-12) in an out-of-school activity to demonstrate the principles of jet engines. *Lower center*—One of several autoradiograms made by Allan Pestcoe (Region IV; Grades 9-10) to demonstrate the effects of herbicides on the absorption of sulfur in plants. See pages 198-201 for the story on the program and a complete listing of all winners.

Reader's Column

Although a Life member of this Association for a number of years I have never taken the opportunity to express my opinions about Association activities. However, now is the time for a few comments.

First, I am perfectly satisfied with the Association in every way and have no complaints. I wish to commend you for all the exceedingly helpful and interesting publications and services. Everything I receive and read is well worth the membership fees and I am only sorry not to have become a Life member years ago.

Second, the section of *The Science Teacher* concerning demonstrations and experiments is wonderful and the part of each magazine that my pupils wear out first even though I teach only junior high school pupils.

Third, I wonder what happened to the proposed new volumes of the *Science Teaching Today* experiment booklets. I have only seven and always look for a notice concerning more. I have already used four sets in my classes—don't tell me such a fine project didn't succeed. I think it might be helpful if you included only one copy in a Packet sometime to let teachers see them. Some of us do have to buy our own materials, you know!

Fourth, the February issue of *The Science Teacher* contains two advertisements of material that I think every teacher should send for. The Standard Science Stencils product on page five is something I have been looking for for years. To those of us who teach science and can't draw or even trace well these stencils are a good relief from hours of work. The advertisement indicates that 300 copies may be made from one stencil. I bought a Pak and got 500 excellent copies and didn't even use good paper. The Projecto-Charts on page six are equally ideal in a difficult teaching situation. I am almost tempted to revise my course of study to include Science Stencils, Projecto-Charts, and the demonstrations and experiments as found in "Classroom Ideas."

Fifth, I guess you have read enough for one day but this letter constitutes long years of finally getting around to having my say. You people are doing a wonderful job.

A. Lovell Parsons
Junior High School
Winchester, Massachusetts

Home-Experiment Ideas Wanted

Can you suggest a simple, new experiment illustrating a scientific concept? It should be one that any father and son can perform at home without buying costly materials or apparatus. It should be entertaining as well as educational. And it should not have been described previously in textbooks or popular periodicals.

If you can, explain your idea as briefly and accurately as possible, in words, pictures or photos and submit it to The Home Experiment Editor, Popular Science Monthly, 353 Fourth Ave., New York 10, N. Y. This magazine will pay promptly and well for acceptable suggestions, which can be used by staff writers, photographers and artists to prepare such material for publication in the magazine's columns.

THE SCIENCE TEACHER

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This Issue . . .

of *The Science Teacher* concludes the spring series. The next issue will appear in September. We remind you to send us your changes of address so that future issues will be delivered promptly. (Second-class mail is not forwarded.) New addresses received by June 1 will be incorporated in the listing for the *1956 Membership Directory*. The Editor.

Editor's Column

As an occasional writer of editorials and such, and as one for whom the spoken word is a means of livelihood, I am in an extremely vulnerable position to say this; but the fact is, *most of us talk too much!* At least, our pronouncements bear a dangerously high ratio to our performance.

It is relatively easy, very respectable, and extremely satisfying to comment on what is right and what is wrong, to recommend activities for others, or to observe "what might happen if . . ." Now of course there is plenty of room for educational leadership exerted through the written and spoken word. The fact is, however, that most of us have neither the wisdom nor the eloquence to inspire others to great deeds. Even if we did, there is still plenty of *doing* to be done. We need the inspiration of far-sighted thinkers and the suggestions of capable teachers. We also need the media of mass communication and professional interchange which we currently enjoy. But we cannot be content merely to *talk* about these things. We must also *do* something about them!

It is a popular parlor game these days to complain bitterly of our lagging supply of scientific and technical manpower, or to extoll the virtues of physics as a requirement for all high school students. "Wouldn't it be better if our science teaching placed more emphasis on problem solving?" pleads a well written article. It is a tempting sport to have scientists and educators square off at each other and boast of what their respective groups could accomplish if only they had the chance. For the most part, this is just *talk*. The talk is fine, of course, but it suffers sadly unless accompanied by generous quantities of productive activity.

Last week during a single day I witnessed two outstanding examples of situations where professional people were not content with mere talk. One of these was a newly formulated television program, "Explorers of Tomorrow." This public service feature is sponsored by a state Academy of Science and is aimed at developing science-oriented curiosity and activity in grade school children. The producers offer this as their means of *doing* something about the current shortage of scientific manpower.

The other example was "Science-Aviation Day", an enterprise carried out by an Elementary School Science Association with the cooperation of a state Aviation Education Association. Over a thousand elementary school teachers heard a keynote speaker, witnessed science teaching demonstrations, examined student-made exhibits, and inspected displays of modern equipment. Nearly half of the participants took low-cost orientation flights to survey their community and environs from the vantage point peculiar to the air age.

Most of us will produce more changes in the behavior of people through what we *do* than through what we say. Our responsibilities as teachers provide multitudes of opportunities for such productive action.

Robert Stollberg

President

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CHARGE-CARRYING BELT To the terminal, charges are conveyed by an endless band of pure, live latex—a CamboscO development which has none of the shortcomings inherent in a belt with an overlap joint.

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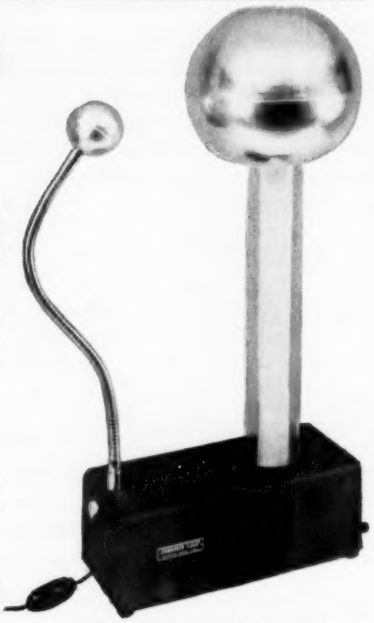

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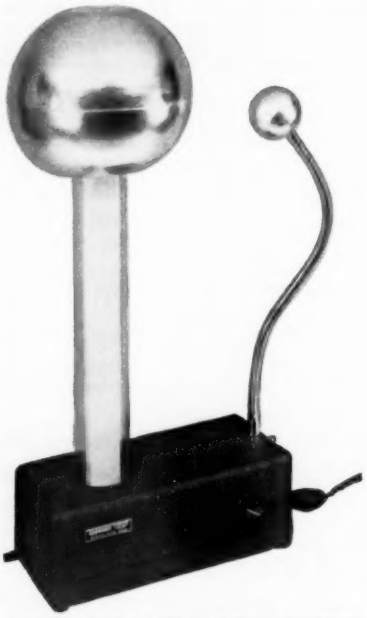

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THE SCIENCE TEACHER

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The National Science Teachers Association is a department of the National Education Association and an affiliate of the American Association for the Advancement of Science. Established in 1895 as the NEA Department of Science Instruction and later expanded as the American Council of Science Teachers, it merged with the American Science Teachers Association and reorganized in 1944 to form the present Association.

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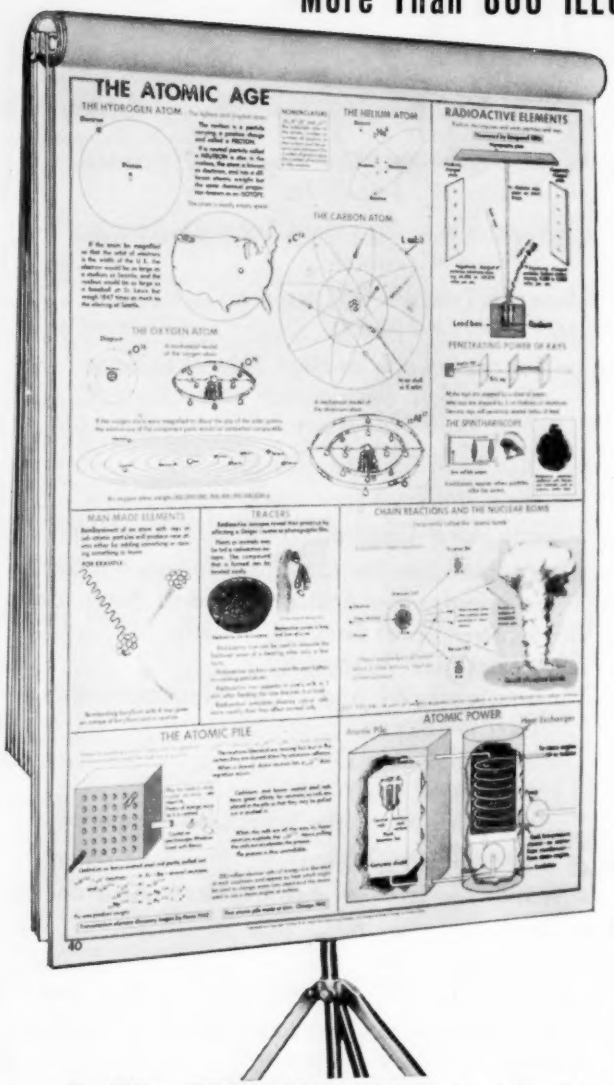

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Manufacturers of Scientific Instruments and Laboratory Apparatus

THE PHILOSOPHY OF TEST CONSTRUCTION IN SCIENCE*

By GEORGE W. ANGELL, JR.

Educational Testing Service, Princeton, New Jersey

ANY TEACHER SHOULD BE CONCERNED with her class as a whole and the students as individuals. A good teacher is primarily concerned with the student as an individual, not only in relation to the other students in the class and to other similar students in the general population, but also in his strengths and weaknesses relative to his inherent capabilities. To aid the teacher in her appraisal of the individual are numerous standardized instruments of measurement, or the teacher may design and construct her own instruments to appraise particular characteristics of the student in his own situation. The all-pervading purpose of these tests is to make possible more accurate prediction and control in the educational process. The value of any test depends upon the extent to which the teacher has clearly in mind the answers to these questions:

1. What changes in behavior are desirable?
2. How can these changes be measured?
3. What aptitudes are essential to the development of a given form and level of behavior?
4. What are the crucial elements of the educative process?

The value of educational measurement depends upon the validity of the answers to these questions.

If we agree with Walter Cook of Minnesota, education has two main functions: the integrative and the differentiative. Within the limits of individual aptitudes, integrative education is designed to make people alike in their ideals, values, loyalties, virtues, language, and general educational and social adjustments. It is often referred to as general education. It unifies and gives cohesion to the social group. Differentiative education is designed to make people different in their competencies, to prepare them for the professions and specialties. The elementary school is concerned mainly with the integrative function and the high schools to a large extent; but at the college level, especially the last two years, any general education usually tends only to supplement professional and special education.

In those segments of the educational system where general education is emphasized, it is the obligation of the teacher to adapt her teaching, and, if you will, her subject-matter, to the aptitudes and abilities of her students. In order to achieve this, she should know:

1. the general scholastic aptitude of the student
2. any outstanding specific aptitudes the student may have
3. the student's general personality pattern
4. the student's particular interests and hobbies
5. the student's environmental situation, past and present
6. the relative strengths or weaknesses of the student in the basic skills
7. (if the teacher is teaching in a secondary school) the relative strengths or weaknesses of the student in the teacher's particular subject area

A combination of currently available standardized tests may be used to throw considerable light on

* Condensed from a talk given at the NSTA Winter Meeting, Atlanta, Georgia, December 29, 1955.

the basic nature of the individual student, his current educational status, and his potentialities for further development. There are three general types of tests: achievement, diagnostic, and prognostic. Since the three types of tests are more alike than they are different, let us consider the use of instruments designed to measure in the area of achievement.

In using an achievement test, a teacher will ideally test her class in the fall to determine the educational status of the class as a whole and of the individual student as well. In light of these pre-test results she will design her course for the year. Throughout the year she will test at frequent intervals to learn whether growth is taking place, whether she is doing an adequate teaching job, and whether her selection of course-content is meaningful. At the end of the year—as a summary measure —she will administer a final examination. This may well consist of two parts: a standardized test, so that she may compare her class with a national—or system-wide—standard, and one part which she has designed to measure those concepts and abilities she has stressed and which are not covered by the standardized test, or are not in the same balance in the standardized test as they were given in her classes.

Although the teacher, in the belief that the ultimate goal of teaching is to aid in the maximum development of the individual student's inherent capabilities, may have endeavored to teach in such a way as to develop a range of abilities rather than to dwell solely on factual recall, the tests available to her are concerned almost completely with informational background. How, then, is the teacher who has tried to develop in her students such abilities as the ability to reason quantitatively, or to evaluate the claims of others, to evaluate her teaching? Admittedly, the problem is not an easy one, it is not insoluble.

Recently the staff of the Cooperative Test Division of the Educational Testing Service decided to try to develop a battery of articulated tests in the areas of academic ability (i.e., aptitude), English composition, listening, reading, mathematics, social studies, and science for four levels—grades 4-6, 7-9, 10-12, and 13-14. Each level test was to be articulated with adjacent level tests so that a continual growth measure could be obtained over the period of grades 4-14.

The first problem was to determine what should be measured in each area. A panel of eminent science educators was appointed to define the scope of the tests in science. Since the needs of the general student are all too often ignored in many present curricula, the committee agreed that the tests should be constructed to measure the educational outcomes of a theoretically ideal course for general students in the overall area of science. The implicit assumption was that *all* students should have been taught those important concepts in the several areas of science which have significance for the well-educated person in understanding and dealing with his environment. An ideal curriculum should be designed in such a way as to develop in the student, not only an understanding of the significant concepts of science, but the ability to use his knowledge as a responsible member of society. The committee agreed that the tests must be constructed with attention given to three different dimensions: first, the aspects of the influence of science upon society; secondly, the abilities which should be developed through adequate science teaching; and third, the basic concepts and understandings of each of the sciences.

It was recognized that each of the aspects of the influence of science upon society involved numerous problem areas; for example, the economic aspects of science involved such problem areas as conservation, industrial application of science, mining and fuels, and agriculture. After considerable discussion the committee agreed upon four major aspects of science: economic, cultural, social, and an around-the-home, or practical aspect.

The committee also agreed upon six abilities which, they felt, should be developed through adequate science courses. Inherent in each of the abilities was the ability to apply scientific knowledge to familiar or unfamiliar situations. This, in essence, is what the tests were designed to measure—the ability to use scientific knowledge to solve problems. The list of abilities was as follows:

1. *Ability to identify and define a scientific problem*

   Included within this category is the ability to isolate a problem from a mass of given material and to formulate the problem in a way which allows for systematic solution.

2. *Ability to suggest or screen hypotheses*

   Sub-abilities here include the ability to suspend judgment, the ability to recognize cause-and-effect relationships, the ability to recognize the possibility of testing an hypothesis, the ability to recognize the logical consistency and plausibility of an hypothesis, and the ability to check it with relevant laws, facts, operations, or experiments.

3. *Ability to select validating procedures*

   This encompasses the design of experiments

and planning the collection of appropriate data.

4. *Ability to interpret data and draw conclusions*
   This includes the ability to formulate valid conclusions and to recognize or draw generalizations from data known or given.
5. *Ability to evaluate critically claims or statements by others*
   This encompasses the critical evaluation of advertisements, written materials, and audio-visual materials. Also included is the ability to detect superstition and fancy, and to recognize the pseudo-scientific and the use of unwarranted extrapolations or generalizations. Other abilities here are the ability to distinguish among fact, hypothesis, and opinion, and the ability to distinguish the revelant from the irrelevant.
6. *Ability to reason quantitatively and symbolically*
   a. To understand and use numerical operations
   b. To understand and use symbolic relations
   c. To understand and use information presented in graphs, charts, maps, and tables

   This ability is essentially manipulative: interpretative aspects are included under ability 4. Thus, the ability to *read* information from a graph would fall into this category, but the ability to *interpret* or draw conclusions from the material presented in a graph would be classified under ability 4.

The third dimension, subject-matter, comprised the conventional areas of biology, physics, chemistry, meteorology, astronomy, and geology. The committee was particularly emphatic in indicating that only the most important concepts and understandings in each of the sciences should be measured.

In order to assure adequate attention to each of the three dimensions, the committee decided that each test should consist of sets of objective questions, each set being based on a single brief problem which would be presented verbally, graphically, or pictorially. Within any set should be questions measuring different abilities and involving different concepts. Each question should measure both a specific ability and a specific concept. The problem situation should be presented briefly but clearly, so that reading ability would not be too great a factor.

Two months after the meeting of the panel, a two-week workshop was held for the purpose of test-writing. Members of the workshop included the panel plus nine other teachers, so that there were three to four workshop members at each grade level.

It was recognized that the construction of test questions is a highly individual matter and that different writers use quite different methods. Generally, however, the best items are produced by first selecting situational material in the problem area in which it is desired to measure, and then selecting a specific ability and a specific concept related to the problem. The question is then written considering both ability and concept at the same time. This method tends to insure balance in the concepts and abilities measured. This was the method suggested to, and generally used by, the workshop members.

Among the advance materials sent to the workshop members was a list of some important concepts in science. It was suggested that perhaps the best way to use the list in writing individual questions was to select an appropriate concept directly related to a chosen problem situation, and to ask the question, "What is the important understanding inherent in this concept that I should measure?" Often there were several important understandings, and a number of understandings of only secondary importance, related to the concept. For example, having selected situational material in the problem area of conservation, and having decided to measure the ability to interpret data and draw conclusions, the writer might select the concept of chemical change for the focus of the question. However, the problem immediately arises as to what phase of the concept should be measured. Certainly the junior high school student should not be expected to know the difference between matathesis and simple decomposition, or the equations describing the decomposition of protein materials found in some organic fertilizers. The question might, however, be so phrased as to measure whether the student recognized that energy changes are involved in all chemical changes. It was, therefore, apparent that the list of concepts, though useful as an idea-source, had to be translated into terms of the particular important understandings before it was usable for actual inclusion in questions.

One outcome of the two-weeks workshop was the production of nearly twelve hundred questions in over one hundred twenty sets. Each set and each question was carefully reviewed by each level committee in terms of appropriateness of abilities, concepts, and aspects, and technically for ambiguities and level of reading difficulty. These test

questions have been pretested on a sample of students at each level drawn from the general population. Those questions which have been found acceptable by the committee and which, in addition, have proved to be statistically sound are being assembled into final forms. These tests will be normed in the spring and will be available in the fall of 1956.

To make clear what the committee had in mind, and the way in which they implemented their ideas, here are two example sets of questions, one from material written for the junior high school level, and one from the material written for the senior high school level.

ILLUSTRATIVE TEST QUESTIONS

Aspect of Science: Economic

Grade level: 7-9

Questions 1-4

A farmer had a farm consisting of fifty acres of hillside land and fifty acres of level land. He wanted his farm to be as productive as possible.

1. After a heavy rain the farmer found a gully forming on the hillside land. The most likely reason for the development of the gully was that the
   (A) ground was bare of vegetation
   (B) farmer had plowed the ground in furrows
   (C) farmer had planted deep-rooted crops
   (D) soil was too rich

2. When the crops were growing the farmer noted that in some areas of the fields the plants were greener than in others. He asked several neighbors why this had happened. The following explanations were given. Which one is the most probable?
   (A) Those parts which were greener had been sprayed with insect poison.
   (B) The greener areas had received more fertilizer than the other areas.
   (C) The greener areas were drier areas.
   (D) The greener areas were more closely seeded.

3. The farmer had heard that some soils were acid and some were alkaline. He decided to test his soil by shaking some soil in a container with distilled water and then testing the mixture with litmus paper. The best way to choose the soil to be tested would be for him to select
   (A) several samples from various parts of the field
   (B) a sample from the lower end of the field
   (C) a sample from each corner of the field
   (D) samples from sandy areas only

4. The farmer decided that he would use next year's crop to enrich the hillside soil. The best procedure would be to
   (A) plow the ground very deep before planting
   (B) plant deep-rooted crops
   (C) plant oats and cut them as a hay crop
   (D) plant clover and plow it under

Aspect of Science: Economic

Grade level: 10-12

Problem area: Conservation

You are the engineer directing a new dam project on a certain river. You have a team of scientists, i.e., biologists, chemists, geologists, meteorologists, and physicists in assistance on the project. You have to locate the dam in the best position, and arrange for the hydroelectric power and the irrigation of the surrounding district, which is a semi-arid region. The water level is to be about 300 feet above the river.

Subject-matter area: Geology

Concept: Diastrophism

Ability: To identify and define a scientific problem

1. Of the following the most important problem requiring your attention would be
   (A) to find the point where the river banks come closest together
   (B) to find the point where the largest and deepest lake could be built up behind the dam
   (C) to investigate the characteristics and structure of the rocks underneath the river bed and along the banks
   (D) to determine the least amount of inhabited land that would be flooded

Subject-matter area: Chemistry

Concept: Chemical change

Ability: To interpret data and draw conclusions

2. Which of the following might most logically be produced near the dam?
   (A) Aluminum
   (B) Sulfuric acid
   (C) Gasoline
   (D) Pig iron

Subject-matter area: Chemistry

Concept: Acid-base reaction

Ability: To interpret data and draw conclusions

3. Part of the water is used for irrigation. A sample of the water from the river is mixed with a sample of soil, filtered, and concentrated. The resulting solution turns red litmus blue, has a bitter taste and a soapy feel. Which of the following conclusions is justifiable?
   (A) The soil is acidic.
   (B) The soil is alkaline.
   (C) The river water is alkaline.
   (D) None of the above conclusions is justifiable.

(Please continue on page 202.)

TODAY'S PSYCHOLOGY CAN HELP TEACHERS TEACH

By RONALD R. EASTER

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TEACHERS SHOULD REVIEW their day-to-day teaching practices in the light of today's psychology. Practical changes have taken place that make psychological principles easier to understand and apply. These changes have occurred so naturally and quietly they may not have been noticed.

Today, psychologists are taking the best ideas from all important groups, then testing. They have tested and tested until there is appreciable statistical evidence about many ordinary teaching and learning situations.

If a teacher knows some of his methods are substantiated by the best testing and thinking available, his confidence and clarity of purpose increase. It is a thrill to see students motivated, to get results from the motivation, and all the while to be confident that time and energy are not being wasted by obsolete methods.

Four important theories are briefly surveyed in this article. Then to bring the theories right into the classroom, ideas that have worked well in the author's chemistry classes are presented as practical applications. The applications are selected from high school chemistry but it is inferred that similar possibilities exist in other classes.

Thorndike's Connectionism

Thorndike and his students at Columbia University have dominated thinking about learning theory since 1898. That theory is based on association between a "stimulus" and a resulting action that is often called a "response." The association between a stimulus and a response came to be called a "bond" or a connection.

In these days of "mechanical brains," the connection might be likened to a relay or some device that completes a circuit under certain conditions. Some psychologists say the human brain must have as many as 9 billion connectors. It has been determined that to activate so many mechanical devices would require more power than is available from Niagara Falls.

In experiments set up to test this type of learning, the learning curves for animals and men were similar in character. That is, the first trials take longer, but the later trials get shorter *gradually* and *irregularly*.

Hilgard has summarized Thorndike's position on some "typical problems of learning." Regarding the effect of *practice* in learning he says,

> Repetition of situations does not in itself modify connections. Repetition of connections leads to a negligible increase in strength, unless the connections are rewarded. Practice is important because it permits rewards to act upon connections.[1]

It is possible to put these ideas to work if a class is required to do any rote memorization; i. e., memorization quite unrelated to meaning.

For example many high school teachers use *valence* to help students learn how elements combine to form compounds. In nearly every high school chemistry text there is a table of important valences and symbols. If those valences and symbols are learned by the student it not only saves much of the student's time later but makes possible easier understanding of formula writing and chemical equations. According to the Thorndike theory, what is wanted is strong mental bonds between the names and symbols of the elements and their respective valences.

It is evident from the theory and test results, mere repetition of the elements with their valences would not provide the best learning situation. Punishments provided during the learning period would not speed the learning as would a more positive approach.

Rewards in this case could be provided and intrinsic (internal) rewards would be better. Learning the valence would be reward in itself if the student could know: (1) that he would have many uses for the fact after learned and (2) that knowing the fact would save him time in the end. Teaching in line with the theory would include emphasizing by careful explanation and by citing examples. Then as formulas are studied, careful pointing out of how valence knowledge is a help would be correct procedure. Each time valence is useful it could be made evident, until the student sees the reward without question.

The association theories are thought by many psychologists to be especially limited with respect to

[1] Hilgard, Ernest R., *Theories of Learning*. New York: Appleton-Century-Crofts, Inc., 1948.

such questions as: (1) How are past experiences used to solve problems? (2) What about the effect of *arrangement* in making a problem easy or hard? Gestalt psychology had its start and its greatest successes in the field of *perception* and its relation to background and organization.

Gestalt Theory

Gestalt is not a man's name but rather a German word related to the form or shape of an entire configuration. The theory is partly based on the idea that the whole is more than the sum of its parts; i.e., a house is more than the lumber, stone, and metal it is made of.

There is empirical evidence to support both the association and the Gestalt theories of learning. The trial and error method has been demonstrated by learning with a maximum of fumbling—with learning taking place gradually and with little understanding about what made the improvement. On the other hand there are learning curves for experimental situations that *clearly show when the learner understands the relationship and from then on gives correct solutions consistently.*

In chemistry nearly all good demonstrations and laboratory experiments could have as their goal: that the student gain insight. If a demonstration is being presented, it follows that the teacher should: (1) carefully review previously understood facts that lead up to the demonstration, (2) present the parts of the demonstration in the best order, (which means in the most logical order conceivable), (3) review the logic after the demonstration, and (4) ask leading questions to test if insight has been achieved.

Lewin's Topological and Vector Psychology

Lewin belonged to the Gestalt group of psychologists but he had enough original ideas to be considered separately. He has taken real psychological problems and tried to find types of mathematics to fit them. He has been at least partially successful with some geometric space relationships and some vector diagrams.

In treating motivation he went beyond anything other writers had treated. If a high school chemistry teacher would make use of Lewin's theory he would need to know why each of his students elected to take chemistry. Each student with a valid reason for taking it should be helped daily to see how the day's work fits his own ultimate goal. It involves making each student a satisfied customer by using the day's tasks to work toward his ambition. Such understanding on the part of the student provides intrinsic rewards that keep him "in the area without policing."

Lewin used vector diagrams to explain the importance of correct degree of difficulty. If tasks are too easy the student has no thrill even when accomplished. If they are too difficult or if the student feels sure there is no possibility of accomplishment he certainly will have no "psychological failure."

Current Functionalism

Current functionalism is not as unified or organized a theory as the preceding ones. This theory does not provide many direct answers to educational problems. A study of it regarding a certain problem would probably reveal the answer: "It all depends on conditions." It tends to collect ideas from other theories, tries to resolve the differences, and use what is "functional." That probably summarizes the value of it.

From the standpoint of high school teaching, the most interesting studies have to do with *frequency* as related to *practice* in learning. The element-valence learning situation described earlier is improved if the teacher describes a series of practice periods with suggestions about how much should be accomplished in each.

Does a teacher need to know what psychologists have learned? Good teachers use some techniques that are as good as any the psychologists propose. Some do it knowingly and some without knowing it. Knowing the most effective methods increases the confidence and morale of the teacher. Correct applications of today's best ideas can speed the learning and understanding on the part of every student.

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IS THE SCIENCE TEACHER SHORTAGE A CURRICULUM FACTOR?

By RAY C. MAUL

Assistant Director, Research Division, National Education Association

IS the quality of instruction in high school mathematics and the sciences deteriorating because of a lack of qualified teachers in the numbers needed? Are opportunities to study these subjects diminishing, i.e., are courses being eliminated because teachers cannot be found at the salaries offered?

Slowly the American public is becoming aware that these questions are vitally related to the present short supply of engineers and scientists. Slowly the realization is growing that it is in the high school that talents are or are not identified, that native ability in certain fields is or is not nurtured, that the ambition to further study is or is not fired, and that careers in science are or are not chosen. In short, the high school (more accurately, the high school teacher) is being recognized as the key to any successful effort to increase the supply of raw material from which engineers and scientists are made. It is the science teacher who recognizes the innate capability of the student, who arouses his interest, who sparks his imagination, who focuses and sustains his efforts, who encourages the superior student to set his stakes high and not to be sidetracked by immediate opportunities for gainful employment. Slowly, too, the public, now being prodded by the clamor of industrial and national defense officials for more manpower in the science field, is awakening to the fact that positive action must be taken. We are being told that Russia annually comes up with twice the number of highly trained scientific personnel that our colleges and universities are now producing. It is said that instruction in such basic courses as chemistry, physics, and advanced mathematics has all but vanished from the offerings of some high schools and that, where this instruction is given, it is sometimes in the hands of poorly qualified teachers. Indeed, the secondary school system stands charged with diminishing interest in this vitally important phase of public education.

Certain much-needed facts are, unfortunately, not available, but the situation can be somewhat clarified by an objective examination of up-to-date information on the supply of and demand for qualified teachers, as brought to light in the Ninth Annual National Teacher Supply and Demand Report.[1] This report confirms the assertion that the situation is critical.

Qualified teachers, ready to enter service at the beginning of a new school year, come from these three sources:

1. The current class of college graduates
2. Graduates of earlier years who, altho qualified to teach, did not choose to do so
3. Former teachers.

The number in the first group—those about to graduate from college—becomes known in March each year. But it is wholly impossible, in the spring or summer before the school year opens in September, to determine how many prospective teachers there are in either of the other two groups. It should be recognized, however, that these qualified graduates of earlier years and these former teachers are in the general population, and that they would be drawn into classroom service in considerable numbers if the attractions become comparatively favorable. But it must also be assumed that the delayed entry of graduates of earlier years or the return of former teachers will occur in meaningful numbers only if new incentives are offered. Since they are not now engaged in teaching, and since teaching today is not more attractive competitively than it was a year ago, large numbers from these sources should not be expected next September. Thus the Class of 1956 will comprise the major known source of new supply.

Before examining the figures contained in the annual report, a word of explanation is timely. Members of the senior class are reported by college officials according to their respective fields of major preparation, and in accordance with the requirements for the standard teaching certificate. All seniors who have sufficient preparation in all three sciences (biology, chemistry, and physics) to qualify for the teaching of general science *are reported in general science only*. Thus those reported in biology do not have the required background in the physical sciences for the certificate to teach general science,

[1] The study was conducted by the Research Division of the National Education Association and the report published in the March issue of the *Journal of Teacher Education*.

and those reported in chemistry or in physics are likewise lacking in some of the requirements to teach general science. *But it does not follow* that those reported under general science are not also fully qualified in one or even two of the three specific science fields. Quite likely, in fact, most of those college seniors who are reported in general science also have the equivalent of a full major in one of the three specific fields.[2] Accurate accounting requires that they be reported only once.

The Gross Supply Figures

Members of the Class of 1956 prepared to become science teachers are distributed as follows:

General science	2,121
Biology	1,547
Chemistry	538
Physics	228
Total	4,434

This means that school officials will have a new pool of 4,434 potential science teachers to draw upon for next September. It must be again emphasized that among the 2,121 reported in general science are doubtless a considerable number with major preparation in one of the specific sciences.

The meaning of these figures becomes clearer when the record for several years is examined. Complete figures are available for each of the past six years, as follows:

Number with major preparation in science	*Year*	*Per cent change from 1950*
9,096	1950	....
7,507	1951	17.5%
5,246	1952	40.3
4,381	1953	51.8
3,641	1954	60.0
3,754	1955	58.7
4,434	1956	51.3

The record concerning college graduates with major preparation in mathematics is as follows:

Number with major preparation in mathematics	*Year*	*Per cent change from 1950*
4,618	1950	....
4,118	1951	10.8%
3,142	1952	32.0
2,573	1953	44.3
2,223	1954	51.9
2,155	1955	53.3
2,600	1956	43.7

[2] In some states, as shown in the appendix of the report cited above, all seniors will have enough spread in all three fields to be eligible for the general science certificate, and will be thus reported.

(Superintendents will instantly recall that each emerging class of college graduates includes many who have major preparation to teach in some other field and minor preparation in one of the sciences or mathematics; college graduation requirements commonly call for both a major and a minor field of concentration. Unfortunately, it has not been possible to develop a reporting procedure to show this added item. It is reasonable to assume, however, that the college graduate's first interest is in the field of his major preparation.)

The Supply Figures Refined

A study of the record since 1950 immediately raises these two questions: (1) Was this supply in 1950 in balance with the demand? (2) How many of these college graduates actually sought teaching positions and entered classroom service in September following their graduation?

Superintendents and college placement officers will probably agree that not all of the 9,096 new eligible science teachers in the Class of 1950 desired to enter teaching, but that there was a consistent demand for those who wanted teaching positions. Only recently, however, has it become possible to assemble accurate data concerning the vocational activities of college graduates who are prepared to enter teaching. Following is an account of members of the Class of 1955:

Field of Preparation	*Number prepared to teach*	*Per cent who entered teaching*
General science	1,788	61.0%
Biology	1,295	55.0
Chemistry	482	46.6
Physics	189	56.9
Total science	3,754	56.4%
Mathematics	2,155	67.3%

These meaningful figures serve to point up the dual nature of the present need: More college students must be induced to prepare to teach these subjects, and school officials must be furnished with the resources needed to attract more of them into classroom services.

A Look at Demand

The facts presented in the preceding paragraphs are, indeed, sobering in their implications. Not only has the gross annual supply of new teachers of the sciences and mathematics dwindled by one-half during the past six years, but school officials have been able to attract only about three of every five potential candidates in this diminishing group. The meaning of these figures is further sharpened, however, when they are compared with the demand for

new teachers to enter service in the high schools of the nation. Data are available to show how many new teachers[a] were employed, year by year, since the beginning of the 1952-53 school year. It is possible to indicate whether the new teacher devotes his full time, more than half time, or less than half time to the teaching of science, as shown in the following table.

NEW HIGH SCHOOL TEACHERS OF SCIENCE

Employed in the year	*Full time*	*More than half time*	*Less than half time*	*Total*
1	2	3	4	5
1952–53[a]	3,009	1,456	2,503	6,975
1953–54[b]	3,264	1,544	2,554	7,362
1954–55[c]	3,514	1,372	2,464	7,350
1955–56[d]	4,152	1,725	2,587	8,464

[a] Based on reports from 29 states. [b] Based on reports from 31 states. [c] Based on reports from 32 states. [d] Based on reports from 32 states.

All of the new teachers reported in this table are full-time teachers; those shown in column 2 have full-time teaching assignments in science; those shown in column 3 devote more than half time to the teaching of science, but each of them carries a minor teaching assignment in some field other than science; those shown in column 4 have major teaching assignments outside science and devote less than half time to any science subject.

The Class of 1955 produced 3,754 fully prepared prospective teachers of science; 2,114 of them entered teaching last September. At the same time, school officials employed 4,152 new teachers to devote full time to science, plus 1,725 new teachers to devote more than half time, and 2,587 new teachers to devote less than half time to the teaching of science.

It cannot be assumed that all of the 2,114 members of the Class of 1955 entered the full-time science teaching positions, altho it is reasonable to assume that they would desire to do so. And it cannot be assumed that all other new science teachers (full time, more than half time, and less than half time) are substandard, or inadequately prepared. Doubtless some, perhaps many are (1) members of the Class of 1955 who have minor preparation in science, (2) qualified graduates of earlier years, (3) graduates who added to their preparation subsequent to their graduation and thus became eligible for the standard teaching certificate, or (4) former teachers returning after an absence of one or more years from classroom service.

The following table shows the employment of new mathematics teachers, year by year, since 1952-53. All are full-time teachers; some devote full time to the teaching of mathematics, others divide their time, as indicated in columns 3 and 4. A review of the most recent record shows these facts: The class of 1955 produced 2,155 fully prepared prospective teachers of mathematics; 1,450 of them entered teaching last September. At the same time, school officials employed 2,723 new teachers to devote full time to mathematics, plus 1,750 new teachers to devote more than half time, and 1,515 new teachers to devote less than half time to the teaching of mathematics.

NEW HIGH SCHOOL TEACHERS OF MATHEMATICS

Employed in the year	*Full time*	*More than half time*	*Less than half time*	*Total*
1	2	3	4	5
1952–53[a]	1,638	1,465	1,380	4,483
1953–54[b]	2,112	1,676	1,512	5,300
1954–55[c]	2,300	1,618	1,292	5,210
1955–56[d]	2,723	1,750	1,515	5,988

[a] Based on reports from 29 states. [b] Based on reports from 31 states. [c] Based on reports from 32 states. [d] Based on reports from 32 states.

More Facts Needed

The foregoing data became available thru the annual national survey of teacher supply and demand. They focus attention upon the critical need for much more information before charges against the American high school can either be supported or refuted. Little is now known about (1) the number of competent teachers in each field of instruction who quit the classroom at the end of each year; (2) the reasons they leave teaching; (3) the sources from which new teachers come; (4) the extent to which new teachers are prepared for the specific assignments they accept; (5) the extent to which teachers already in service are shifted to the fields of greatest shortage; (6) the fitness of such teachers for their new assignments; or (7) the extent to which courses are dropped from the instructional program because teachers, competent or otherwise, cannot be employed at the salaries offered. Such facts as these and others are needed if we are to describe the current scene and predict future trends with reasonable accuracy.

[a] A "new" teacher is defined as one who was not employed as a teacher the preceding year; he may be an inexperienced college graduate of the current or any earlier year; he may be a former teacher, a returning soldier, a worker in any other gainful occupation, an unemployed person; he may or may not be adequately prepared for the assignment he accepts—the only criterion is that he satisfied a demand for a new person to join the total high school teaching corps of the nation.

College Teachers Look at High School Science

By RICHARD M. SUTTON

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MORE IMPORTANT THAN any list of topics or particular experiments which a high school student should study in physics, I would place as the highest aim of his course an introduction to *exact, quantitative thinking,* and *careful observation.*

To attain that aim, certain attitudes and skills can be stressed. The student (and teacher) should try to:

1. Master exact, unambiguous *definitions* of scientific terms. A clear definition is like a sharp tool —useful when you know how to use it. Most definitions in physics are working tools; they tell how to proceed from given items to desired ones; their compactness helps to eliminate a lot of fuzzy thinking.

2. Know high school *mathematics as a working tool.* Many students who can factor a polynomial or solve simultaneous equations do not see the relation of these skills to physics. All of the problems of physics are "word problems." The student needs to learn how to translate problems into the necessary equations. He needs to know how to make his geometry, algebra, and trigonometry, not to mention his arithmetic, work for him. There is no place like physics to discover the value of these tools.

3. Work for clear understanding of the *"laws of physics."* These are not phrases and sentences to be repeated from memory, but *living principles,* which, in a few words, capture a tremendous amount of meaning. After thirty-three years of teaching, I can still find new meaning and excitement in the application of Newton's laws of motion and Ohm's law. Fewer principles, taught with deeper insight, should accomplish more than an attempt to teach many principles in a slighting manner. The teacher himself must, however, see the depth of meaning in these principles. He should be creative in his thinking about them.

4. Have an *inquisitive attitude of mind* that keeps on asking questions. Too many students stop asking questions. Many years ago, a high school teacher of physics said, "I can tell more about your understanding of the subject by the kind of questions you ask than by any other way."

5. *Observe carefully* what Nature does. Make her do your bidding by asking "experimental questions." Nature will usually give a clear answer to a clearly formed question if you persist in inquiring. I wish more students had more interest in simple experiments. Wherever I am, I get a great kick out of trying to make physical measurements so as to draw reasonably valid conclusions with whatever implements are at hand—not with just the equipment of a laboratory.

6. *Learn to validate his own conclusions.* As the solution of an equation can usually be "checked," so conclusions drawn from physical laws can usually be checked, either mathematically, or by experiment. Greater emphasis on *dimensions* and *units* in the work that the student does with equations, can prevent much sloppy thinking. Most equations in physics can be, in a sense, self-validating.

7. Go beyond blind substitution in formulas to get "answers." Get students to think out their own formulas where needed. Many good problems cannot be answered by substitution in any formula in any book, but many can be worked by understanding of principles and reasoning from them. This type of thinking is not beyond able high school students; but their teachers *must lead them in it.*

By WILLIAM T. LIPPINCOTT

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THE PATTERNS AND PURPOSES of elementary chemistry courses, both in high schools and colleges, are widely diversified. There are, however, five major pedagogical problems which all high school and college chemistry teachers face. Most of the five are not peculiar to chemistry but the chemistry teacher is in an excellent position to make important contributions to their solutions.

The first of these problems, *teaching systematic thinking,* is surely a critical one. If our students learned nothing more from elementary chemistry than to approach problems of all kinds in a logical and systematic manner, teachers could feel gratified

indeed. How many times during a school year have we heard a student say, "I could have solved that problem on the test if only I had known how to start it?" How many more times have we heard, "I can't solve numerical problems because I'm not good at math," from students who never have trouble manipulating figures when *their* money is involved? Then too, we have often heard, "I don't see why I have to memorize all of these equations." In nearly all such cases the students have either refused or were never taught to discipline themselves to approach problems systematically. Chemistry offers many excellent opportunities to teach this concept. Typical examples are: solutions to numerical problems, the reasoning which enables scientists to speak with some certainty about the structure of the atom, and the assembling and weighing of a group of facts in developing a theory or hypothesis—such as the kinetic molecular theory.

The second problem, *making students science conscious and science curious,* hardly needs justification in modern America. The chemical industry, which in 1955 grossed more than 23 billion dollars, is the nation's leading industry. At least three students out of every two hundred in your school will work in chemical industry after graduation, most of them in non-technical jobs. Couple these facts with the current applications of atomic energy and the recent successes of new drugs and techniques in medical research and it becomes a necessity to be certain our future citizens have a deep-rooted appreciation for and interest in science and scientists.

Stimulating student imagination, the third problem, is one which all teachers face. One of the criteria of a mature mind is that it be wisely imaginative, and the training of mature minds is every teacher's goal. To students of chemistry, imagination is a virtual necessity. Each student must be able to formulate in his mind's eye a picture of molecules, ions, or atoms reacting with one another or undergoing physical changes. Good chemistry teaching should be top-heavy with techniques designed to develop, guide, and nurture student imagination.

The fourth problem, *instilling important principles of chemistry into the minds of students,* is perhaps least easy to justify for those who will have no intimate contact with science beyond the elementary level. For others, no amount of effort and assistance in this direction by teachers is too much. It has been estimated that there was a shortage of 30,000 personnel for science and engineering posts in industry, government, and teaching in this country at the end of June, 1955.[1] No relief from this shortage is in sight unless and until more students with strong interest and ability in science are trained and trained well.

But suppose we consider the student who plans a non-science career. Is it not important for him, too, to assimilate a reasonable body of facts and ideas concerning the "chemical" portion of the world around him? Should not he be familiar with the chemical processes he observes daily, the structure of the materials he uses constantly, and possibly a few of the chemical reactions which keep his body alive and healthy? Surely the answers to these questions are yes and surely also the problem of teaching the fundamentals of chemistry is a vital one.

The fifth problem, *providing experience in and appreciation for experimentation,* is closely related to the first four. However, it is so significant that it will be discussed independently.

Think of the major changes in living in America since 1940, as television, frozen foods, automatic washing machines, automobiles with automatic transmissions, plastic items—from furniture to bottles, synthetic fibers, and many others. How many of these developments would have been possible without experimentation—people using their hands to develop ideas?

The experiments which ultimately led to television were carried out by an English physics professor about 1850. The development of nylon resulted when chemists tried to carry out in the laboratory a process similar to that used by silk worms in making silk. The Salk vaccine evolved from skilled hands and skilled minds working in unison in the laboratory. In all of these cases many experiments were tried but few were successful. Nevertheless, it was the persistence, the systematic thinking, and imagination—plus a little luck—which spelled success.

The young people who take our courses can gain much from well directed experimentation.

These five problems present a real challenge to all elementary chemistry teachers. There is, of course, no ideal solution to any of them. However, the following suggestions are presented to formulate a foundation from which each teacher using his initiative, intuition, and imagination can build the kind of program he feels is most successful.

One, *teaching systematic thinking:* This can best be done in two ways. The first is by establishing a thoroughly planned, integrated course of instruction premised on the structural aspects of chemistry and carrying this theme throughout the program. This involves inclusion of numerical problems which students are taught to solve by reasoning rather than

[1] Barker, J. W., *American Scientist,* 43: 385 (1955).

by memorizing a solution and trying to fit this to all problems. The second is by developing a technique of presentation which starts with a slow, deliberate—spoon-feeding—stage and progresses as rapidly as possible to the point where the student thinks independently, predicts properties of substances he has not studied, solves problems he has never met before.

Two, *making students science conscious and science curious:* Here, the problem suggests the solution. Enthusiastic lectures, highlighted by pertinent illustrations and demonstrations and filled with latest developments pointing out the role of science and scientists in all facets of living, are absolutely necessary.

Three, *stimulating student imagination:* The suggestions in points 1 and 2 apply equally well here. In addition, teachers must exercise careful judgment in quality and quantity of material presented and must give examinations which stimulate rather than deteriorate student morale.

Four, *instilling certain fundamental principles of chemistry into the minds of students:* Here the three key words are lecture, laboratory, and textbook. A successful program must be built on an integrated lecture, laboratory, textbook schedule such that the lectures are reinforced by laboratory and supplemented by text material. The general philosophy and the sequence and selection of material in the text and laboratory manual should closely parallel that presented in the lectures.

Five, *providing experience in and appreciation for experimentation:* In this case the emphasis is not only on "learning by doing" but also on *thinking* before doing. It is of the utmost importance that students, (a) know the purpose of each step they take in the laboratory, (b) be taught to draw reasonable conclusions from experiments, and (c) acquire proficiency in certain techniques such as weighing, filtering, decanting, transferring material from one container to another, etc. In addition, a wise mixture of quantitative, qualitive, and preparative exercises should be included in the agenda.

Successful teaching requires experience, enthusiasm, knowledge of the subject, constant hard work, and a deep affection for young people. Only one of these is acquired from textbooks and journal articles. However, if chemistry teachers everywhere would think on the points presented above when planning and preparing their programs, then perhaps chemistry courses would take on a new radiance.

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Amateur Radio in Science Teaching

By MALCOLM SMITH

The Putney School, Putney, Vermont

AMATEUR radio now offers new and exciting opportunities for the science teacher. Recent changes in the regulations of the Federal Communications Commission make it relatively easy to obtain the requisite license, and low-powered equipment is simple and inexpensive to build.

An active and successful radio club can be founded on a very modest receiver and transmitter, and its supervision does not demand any unusual background or skill on the part of the teacher. A radio club in which all (including the teacher) are beginners is ideal for learning, and there is excellent non-technical literature to facilitate the process. We have found also that such an activity stretches far beyond the club itself. Assembly demonstrations of student-made equipment can be lively and will stimulate a school-wide interest in science and electronics. This type of project need not be limited to the rare student with extraordinary talent, nor does it demand excessive solitary work.

We are putting into practice a scheme whereby our radio club functions as a social group in which the boys and girls work together toward a common goal and do as much outdoor field work as possible. We endeavor to stress the human side of the art of communication and place less emphasis upon immersion in the engineering details.

To be specific, teacher and students will want to begin by working toward the Novice license, which allows a wide range of operating privileges that form a stimulating introduction to "ham" radio. The examination for this license requires only the most elementary knowledge of electronics and FCC rules. One essential requirement is the ability to send and receive telegraph code at the rate of five words per minute. This skill can be achieved with remarkable ease when a group is working together, and needs only a high-pitched buzzer, battery, and telegraph key for practice.

The elements of radio theory, rules, and operating practices can be acquired readily from two modestly priced publications—*How to Become a Radio Amateur* and the *Radio Amateur's License Manual*. Both are published by the American Radio Relay League, West Hartford, Conn., which is a large national organization of radio amateurs. The books may be obtained direct from the League or from any large radio dealer. Another League pamphlet, *Learning the Radio-Telegraph Code*, may also prove valuable. For further study in greater detail, the *Radio Amateur's Handbook* (by the same publisher) provides a wealth of material in all phases of communication.

Another desirable feature of new FCC procedures is that applicants for the two lower classes of license (Novice and Technician) are examined locally, using question sheets mailed on request by the nearest FCC district office. This eliminates complicated trips to a distant city. Any amateur operator over twenty-one and holding a General Class (or higher) license may administer the test. Most individual "hams" or community radio clubs will be glad to help out.

Many people are inclined to think of radio operating as a matter of long hours shut away from the world in the effort to contact other stations at vast distances. This is, of course, an important and interesting type of work, but it could hardly be fitted into a busy school day and would appeal to only a limited number of children. We are trying a different approach, which appears to be successful.

Let us return to the limitations imposed by government supervision. The initial Novice license is valid for one year only and cannot be renewed, so that long-range plans must include preparation for a permanent license. The usual course is to work for the General class "ticket" which conveys all amateur privileges. However, the examination calls for code at thirteen words per minute, which is difficult to achieve when practice sessions are limited to one a week, as ours are.

We are, therefore, gearing our program of learning to the Technician license which can be obtained with only the previous five words per minute of code speed and the passing of a somewhat more difficult written test. The Technician is permitted to operate in the very high frequency bands—so-called "VHF" and "UHF"—which have come into such prominence with recent developments in television.

In general, these high frequencies are useful for short-range communication, up to several miles with the type of station we are using. But this region of the radio spectrum has striking advantages for a

group with limited funds and time. First, it is not crowded, so that high power is not needed to overcome interference from other transmitters. Second, fascinating work can be done with a minimum "rig" that will take up little space, and will not entail such problems as finding supports for an antenna 130 feet long. Suitable plans and operating suggestions may be found in the *Radio Amateur's Handbook* and in *QST*, the monthly magazine of the American Radio Relay League.

For us, an even more challenging motivation lies in the new and experimental nature of the medium. This does not imply that it is difficult or restricted to electrical wizards, but rather that its possibilities are still partly unexplored and a successful contact over a few miles will rival in accomplishment thousands of miles on the lower frequencies.

It is a wonderful experience to be one of a field party of boys and girls setting up their hand-carried, battery-powered station in some remote spot. Even though the home base may be only a mile or so away, there is an incomparable thrill when successful signals are first exchanged. Not only does this type of activity provide for growth and motivation in science under conditions valuable to the development of the adolescent, but it is closely tied to a real community need. It is precisely this sort of communication which is essential to effective Civil Defense and to many other government and business enterprises that depend on keeping scattered groups in touch with one another.

There are many possibilities waiting to be exploited. For just one example, the club operators can put on a demonstration for a physics or general science class that will lift radio out of the "taken for granted" category and bring it to life as a still new and still growing field. Such a group with small budget and inexperienced personnel will develop slowly, but from the very first it will be a rewarding experience. Old-timers will usually be more than willing to help with advice and aid in construction. The League is a fruitful source of suggestions on how to form a club and other pertinent topics. Give it a try. Hope to see you on VHF!

Pets, Parents, and Children

By ROBERT L. GANTERT
Alexander Hamilton Junior High School, Seattle, Washington

MEMBERS of the so-called lower animal kingdom always have had and always will have a fixed attraction for children of all ages. Unfortunately, this magnetic appeal of animals to children does not generally meet with the same degree of enthusiasm on the part of most parents. As a junior high school science teacher in a large school system, I have daily braved the wrath of irate parents on the subject of encouraging children to own a large variety of pets. In all fairness, however, I must admit that quite often this parental disapproval has been well-justified. I recall one instance where a pet hamster I had given to a seventh-grade pupil slipped free its mooring and got trapped in the intricate mechanism of an apartment house furnace. The end result was a repair bill amounting to $150 for the parents concerned. Another case centered around a white rat. George, as we shall call this friendly rodent, displayed his gregariousness by making periodical trips about the neighborhood in search of house guests to entertain. His success as a socialite and all-around good fellow was testified to by the number of wild brethren he succeeded in bringing home with him from time to time. At the urgent request of the boy's parents, I dutifully performed the dual role of pied piper and painless executioneer.

There are countless other domestic problems which develop out of this question of pets, parents, and children. A few of the more commonplace are hereby enumerated. Baby ducklings swimming in the bathtub, domesticated mice running the gauntlet of overpopulation, deodorized skunks with faulty intestinal tracts, tame raccons with a fondness for expensive nylons, "cute" chipmunks gnawing through upholstered furniture, tropical fish spawning in the best kitchenware, garter snakes hibernating in clothes closets, tree frogs scaling freshly plastered living room walls, young tomcats with bad plumbing . . . these are only a few of the innumerable quirks in personality that have come to my attention during the school year. In the majority of instances, I had supplied the animal offenders concerned.

You would think that in the face of this formidable array of adversity my stand as an advocate

of better and closer animal-child relationship in the home would be seriously weakened. It would be far easier to forsake the natural zoological field and dwell upon a more concentrated study of the areas of physical science such as light and sound. Many junior high school science teachers follow this latter policy. Frankly, I feel this policy indicates a lack of intestinal fortitude and teaching courage. I must even admit that I derive a mild satisfaction and sadistic pleasure from weathering the storms of parental outrage at the continued unorthodox behavior of their children's pets.

My strong belief in the unlimited potential of unusual pets as a basic source for later understanding of human behavior is not an original theory by any means. Animal personalities are featured on more and more TV programs such as the well-known *Zoo Parade*. A child between the ages of twelve and fifteen is passing through the most difficult formative stage of life. Patterns of social behavior are being formed during this vital transition period. The fundamental principles involving consideration, kindness, tolerance, patience, sex, courage, and many other invaluable traits of character can be learned by the child from a careful, guided study of lower animal behavior. In my science classroom we maintain a small rotating zoo. Periodically, we observe actual behavior patterns of certain animals. The qualities of character found in animals are often closely allied to those of man himself. A few classroom experiments include the following: white mice running open and closed mazes; testing tropism behavior of earthworms; observation of the courting tactics of Siamese fighting fish; Mendelian ratio of inheritance as observed by actual crossing of pure white and pure black mice. One of our best pets for classroom study is a young ringtail monkey. This amusing primate, representing as he does the highest order of animals, has actually taught the kids more about human behavior than I could hope to accomplish by hours of pointless lecture.

Monkeys are great imitators and learn very rapidly. However, some of their habits are distinctly out of the realm of good taste. One bad habit which the little fellow learned from the kids was the practice of squirting streams of water across the classroom. The drinking fountain was located across the hall from his cage. His bad habits resulted in solitary confinement and cutting off his food supply for a period of time until he desisted. It seems as though the process of discipline and the correction of faulty learning centers mainly in the stomach of most primates. Of all the methods of punishment I tried, it appeared that only solitary confinement and the lack of choice food brought any worthwhile results.

Every morning before school and every day after school there was a long line of pupils waiting to watch the monkey perform. He was exceptionally friendly and I allowed him the freedom of the entire room during these hours. There was little need to associate the habits of the monkey with those of humans as he constantly displayed such very human traits as selfishness, temper, pleasure, happiness, jealousy, and many other easily observed traits. The kids were always comparing his actions to their own, and the lesson was a self-taught one.

One of the cleanliest and most prolific animals is the common hamster. These little rodents cost only about a dollar in any pet store. However, this is still a sum beyond many a child's means. To make it possible for every child to own a hamster and be able to study it for a protracted period, we formed a Hamster Society. I bought the first two pair, and by careful crossbreeding we soon were able to supply hamsters at the low price of twenty cents each.

I also produced a half-hour TV program using white mice, which ran through a variety of tests designed to test memory and learning. Shortly thereafter, I was again under fire from parents who complained that their children were having "home" TV programs with troublesome domesticated mice. Again I was "That fool science teacher!"

The junior high school child is a complex organism at best . . . to date, no successful approach to vivisection and accurate analysis of his mental processes has been devised. The teacher has only one defense against his attack . . . an inexhaustible supply of good humor. Failing in this the teacher must fall prey to that inevitable badge of teaching courage . . . *the stomach ulcer!*

This perhaps debatable article on *Pets, Parents, and Children* is not intended to mean that all parents should allow their homes to be immediately overpopulated with animals. I am only attempting to point out the often forgotten point that a study of lower animals is necessary if we are to ever understand the higher animal . . . man himself! I have yet to find a zoologist who lacks human understanding. Give me a child who has had experience in taking care of animals, and you have given me a solid foundation upon which to build a useful human being. As a concluding bit of philosophy of my own vintage, I would like to contribute the following scrap of knowledge: Water the roots of the tree of knowledge with humor, trim its branches with courage, and gather its variable fruits with prudence and foresight.

Laboratory Exercises for the Life Sciences

A SERIES OF EXPERIMENTS, DEMONSTRATIONS, AND NEW IDEAS

(Continued from the March and April issues of *The Science Teacher;* concluded.)

The ten experiments and demonstrations presented at the Cancer Information Conference held last October 15 at the National Cancer Institute, National Institutes of Health, Bethesda, Maryland, have been included in response to the many requests for activities to add realism to high school science. We invite you to send us a report on how you may have used these new ideas illustrating techniques and lines of investigation used by scientists at NCI.

We wish again to express our appreciation to these scientists, each of whom is identified in the by-line for his contribution.

DEMONSTRATION OF ENZYME ACTIVITY

By ROBERT E. GREENFIELD, M.D.
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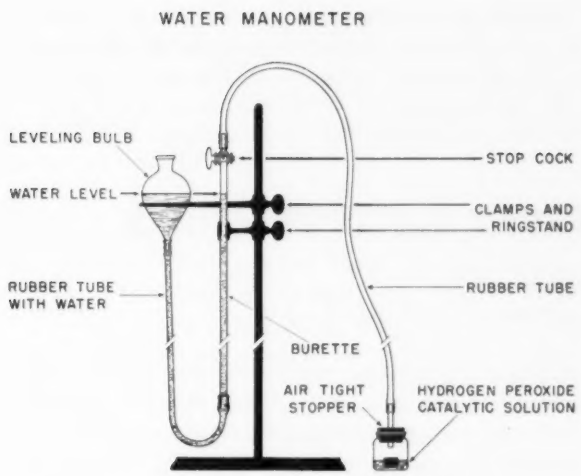
Principles: The myriad chemical reactions going on in a living organism are all affected by biological catalysts, the enzymes. Like other catalysts, enzymes greatly accelerate the rate of a reaction without being used up during the reaction. Part of the enzyme molecule is composed of protein, and this complex portion makes the enzyme active only with chemical reactants of a certain specific chemical structure. Since a knowledge of these enzymatically-controlled reactions is extremely important in understanding the functioning of a living organism, enzyme studies make up an important area of biological research, including investigations on cancer. A number of important differences between enzyme activities in tumor tissue and those in normal tissues, or between enzyme activities of a tumor-bearing subject and those of a normal subject, have been found. One example illustrating such differences is the level of activity of the widespread enzyme, catalase, in the livers of normal and tumor-bearing subjects. This enzyme catalyzes the breakdown of hydrogen peroxide into water and oxygen, and it has been shown by Dr. Greenstein at the National Cancer Institute that the activity of this enzyme in the liver of a mouse bearing a moderately large, rapidly growing tumor (not necessarily growing in the liver) is lower than the activity found in the liver of a normal mouse. If the tumor is removed surgically or if, as happens occasionally in some tumors, it regresses, the catalase activity of the liver will return to normal. A material can be prepared from tumor tissue that will, upon injection into the mouse, cause a lowering of the liver catalase activity. Studies are underway in the attempt to learn the nature of this material.

Catalase is made up of a protein portion, as mentioned above, and of an iron-containing ring structure, called heme which is also present in hemoglobin, the pigment of red blood cells. Even though the same iron-containing ring structure is present in both compounds, the effect of the difference in protein portions of the two compounds is striking since hemoglobin exhibits very little catalytic effect toward hydrogen peroxide while catalase produces considerable effect. Solutions of iron will also show a weak catalytic effect, but 0.0001 milligrams of iron in catalase is more effective than 112 milligrams of iron as a ferrous salt.

Catalase is widespread in many tissues, both plant and animal. A solution containing catalase can be prepared simply by grinding some tissue, such as liver, with water, using a mortar and pestle and a little sand. The overlying solution is then employed for enzyme activity measurements.

The demonstration is designed to show a simple method for the measurement of enzyme activity, utilizing catalase preparations and simple equipment. Directions are also given for comparing the breakdown of hydrogen peroxide when water, a solution of an iron salt, and catalase preparations from the livers of normal mice and from tumor-bearing mice are employed.

Apparatus: A burette is inverted and the tapered tip is connected by means of a rubber tubing to a small piece of glass tube that is inserted through a rubber stopper into a wide mouth bottle. (If a burette is not available a piece of glass tubing about 1 meter long and 8 mm. in diameter makes a satisfactory substitute.) The other end of the burette is connected by tubing to a leveling bulb. Water is



poured through the leveling bulb until the water level reaches just below the stopcock. The rubber stopper is inserted into the bottle. The water level in the leveling bulb is brought even with the water level in the burette and a mark is made at the water level. At a convenient distance (e.g., 1 ft.) down the burette a second mark is made.

A small cap of a medicine bottle is inserted in the wide mouth reaction bottle acting as a cup to hold the catalytic solution. Five cc. of 3% hydrogen peroxide is placed in the bottom of the bottle. The rubber stopper is inserted in the bottle. The water level in the leveling bulb is brought to the upper mark on the burette. On a signal from an assistant the operator shakes the reaction bottle with one hand thus overturning the cup of catalytic solution into the hydrogen peroxide, and with the other hand follows the descending water level in the burette with the leveling bulb. The shaking must be rapid and regular as the liquid in the reaction vessel will accumulate large quantities of oxygen if the liquid surface is not broken continually. An assistant measures with a watch (preferably a stopwatch) the time taken for the water level to descend from the upper to the lower mark on the burette and the elapsed time gives a measure of the reaction rate.

Materials: A. 1 M. solution of a ferrous iron salt (56 mgm. Fe/cc., e.g. 27.8 grams of ferrous sulfate. $7H_2O$ per 100 cc.).

B. Extract of a liver of a mouse (a liver from a rat or a frog can also be used).

Kill the animal by decapitation and bleed from the neck over a beaker containing water. An amount of water in cc. equivalent to forty percent of the body wt. in grams will give approximately a 1/10 dilution of blood if the animal is exsanguinated. Save this diluted blood for testing. After chopping up the liver with some scissors, grind it with 9 parts of water using a mortar and pestle and a little sand. Allow the sand to settle and pour off the overlying supernatant solution. This supernatant solution will contain approximately 0.1 mgm. of catalase per cc. or 0.1 microgram* of catalase iron per cc.

C. 3% hydrogen peroxide (obtainable at any drug store).

D. A watch, preferably a stopwatch, with a sweep second hand.

E. A rat or mouse bearing a large tumor and a corresponding normal animal. Prepare a liver homogenate as described in B.

F. The apparatus as described above and its supports.

Procedure: After each experiment the jar and center cup is rinsed well with water.

1. Place 2 cc. of water in the center cup and repeat the procedure given above to show that hydrogen peroxide is stable under the conditions of the experiment.
2. Place 2 cc. of 1 M. ferrous salt containing 112 mgm. of iron in the center cup and measure the reaction rate. The reaction rate may be better compared to that of the catalase reaction below if the time is measured and recorded. This, however, is not a necessity as the difference is rather striking.
3. Dilute 1 cc. of 1 M. ferrous salt to a liter with water and add 2 cc. of the diluted solution to the center cup. Add 5 cc. of the hydrogen peroxide to the bottle and carry out the reaction as described above. The 2 cc. containing 0.112 mgm. of iron (112 micrograms* of iron) gives practically no reaction.
4. After a new portion of hydrogen peroxide is added to the bottle, add 1 cc. of a 1/10 liver extract containing approximately 0.1 mgm. of catalase or 0.0001 mgm. of catalase iron to the center cup. One cc. should give a reaction too fast to measure by the technique.
5. One half ml. of liver extract from a normal rat may be compared with that from a tumor-bearing rat. This comparison may demand the use of stopwatch timing if the tumor is small. Usually the marked lowering of the liver catalase of the tumor-bearing animal as described by Greenstein, *et al.* may be readily demonstrated.
6. 10 cc. of the diluted (hemolyzed) blood from B is further diluted to one liter. It will still

* 1 microgram equals 0.000001 grams.

contain approximately 5 times as much iron as that found in the catalase preparation used in Experiment No. 4. However, 1 cc. of this further diluted blood gives practically no reaction. If any reaction is present it is due to the catalase normally found in the red blood cells, but at a lower concentration than that of the liver.

CHROMATOGRAPHY AND PAPER ELECTROPHORESIS

By CARL G. BAKER, M.D.

Laboratory of Biochemistry, U. S. National Cancer Institute

Principles: Two extremely valuable techniques that have been widely used in science and technology in recent years are chromatography and electrophoresis. Both methods are used to separate complex mixtures into the individual components. This separation procedure avoids destruction of certain more unstable components that would have occurred if some other methods such as distillation or crystallization had been employed. Furthermore, many separations previously impossible to make can be accomplished by these methods. In certain forms, chromatography and eletcrophoresis offer a simplicity of operation which permits a much more rapid accumulation of information than other methods permit.

Chromatography is used most widely in two forms—column chromatography and paper chromatography. In the column form, separations are achieved by the filtration of a solution containing various components through a column of finely-divided adsorbing material. The components are adsorbed on this material and can be removed later by passing certain liquids through the column. Since the different components are not removed with the same ease, some will move down the column faster than others.

In paper chromatography, a sheet of filter paper can serve like the adsorbing material used in the columns. In this procedure much smaller amounts of material are required and much less time is necessary to "complete a run."

Electrophoretic procedures are based on the knowledge that the components of mixtures carry electrical charges of varying amounts, and they will therefore move at different rates in a salt solution through which a current is passed. Of course, those components carrying a *net* negative charge will move toward the positive electrode and those with a *net* positive charge will move toward the negative electrode. In paper electrophoresis, the mixture to be separated is placed on a strip of paper after the paper is moistened by the solution, and the ends of the strip are placed in two containers filled with the solution. Electrodes are submerged in the container and direct current is passed through the solution. Separation of the components is easily observed if the differently-charged components are of different colors.

When the components being separated are colorless, some means of detection must be employed. It can be done through visualization by staining with dyes or by forming colored products through a chemical reaction, or it can be done by chemical tests. When radioactive materials are separated, detection can be done with photographic film. When proteins are studied, they can be visualized with the dye, bromophenol blue. Amino acids can be seen by reacting them with ninhydrin. Chloride can be detected (after elution of different portions from the chromatogram) by reacting with silver nitrate. Some substances absorb ultraviolet light, and this property can be utilized for their detection and measurement, etc.

Procedures:

A. COLUMN CHROMATOGRAPHY:

1. *Preparation of the adsorbing column:* An ordinary piece of glass tubing, outside diameter of about 8 to 10 millimeters, about 1½ to 2 feet in length, is employed. Ordinary adsorbent cotton is forced in loosely at one end of the tubing for a distance of about 1 inch. With the tubing held in a vertical position (with the cotton at the lower end), the adsorbing material is introduced into the tubing in small portions. A small funnel is useful for loading the tubing. As the adsorbent is added to the tube, the tube is gently tamped frequently upon a wooden surface to pack down the adsorbent. The adsorbent used is magnesium carbonate (USP). After the height of the adsorbent has reached about 6 to 10 inches, it is ready for the addition of ligroin (petroleum ether) to the column. After all the adsorbent is thoroughly wet,

the column is ready for chromatography. It is convenient to place a short piece of rubber tubing carrying a clamp (a screw-type pinch clamp is best) on the lower end of the tubing for controlling the flow of liquid in the column.

2. *Preparation of the extract of leaves:* A large green leaf (spinach works well; in the demonstration given at the National Institutes of Health a leaf from a bryophylum plant was employed since some leaves happened to be available) is cut up into small pieces, (about ½ cm. square) the cut portions are placed in a mortar that contains a little sand and about 70 cc. of ethyl alcohol (other alcohol, such as rubbing alcohol, should also work; the school doctor or a local physician could help obtain the ethyl alcohol) and the contents are ground with a pestle. After the leaf is thoroughly ground, the liquid is filtered through filter paper (if no filter paper is available, the clear overlying solution can be poured off after the sediment is allowed to settle). To the green alcoholic solution is added 25 cc. of ligroin and the two are thoroughly mixed. After the mixture has stood for a few minutes two layers appear; the upper layer is the ligroin solution. The upper layer is separated from the lower layer and is poured into a flat dish. The process is repeated twice by addition of fresh ligroin to the lower layer (these separations can be done best with the aid of a small separatory funnel, but if this piece of apparatus is not available, the upper layer can be removed by sucking it up into a tube very carefully, or if great care is taken it can be poured off, making sure that none of the lower layer is included). The green solution in the flat dish is allowed to evaporate to dryness (this step can be speeded if a gentle blast of air is passed over the dish). After evaporation is complete (and as soon thereafter as is convenient) the residue is dissolved in 3 cc. of ligroin.

3. *Loading the column:* The column of adsorbent should be wet with ligroin, but no free ligroin should extend above the adsorbent more than about ⅛ inch. The 3 cc. of ligroin containing the leaf pigments is carefully poured onto the top of the column (it should be done slowly to avoid stirring up the top of the column). As soon as the green solution has passed into the adsorbent, fresh ligroin is carefully added, and after additional ligroin has passed into the column, the tubing above the column is filled with ligroin. After ligroin has passed through the column for two to three hours, several colored bands of leaf pigments can be seen on the column. The pigments are chlorophylls, xanthophylls, and carotene.

4. *Materials:*
   a. Glass tubing, 8 to 10 mm. outside diameter, about 1½ to 2 ft. long.
   b. Small amount of absorbent cotton.
   c. Adsorbents: Magnesium carbonate, USP (can be obtained at a drug store or chemical supply house).
      Other adsorbents can be used; inulin, alumina, calcium carbonate, and possibly powdered sugar.
   d. Green leaves (frozen spinach can be used).
   e. Mortar (holding about 300 to 500 cc.), pestle and a few grams of sand.
   f. Ligroin (petroleum ether)—the low boiling fraction (b.p. 30-75°C.) of petroleum—about 500 cc.
   g. Alcohol, preferably ethyl, but rubbing alcohol should work—about 500 cc.
   h. A flat dish, such as an evaporating or Petri dish—holding about 100 cc.
   i. Several containers, such as Erlenmeyer flasks or beakers—about 50 and 150 cc.
   j. Convenient articles:
      Small glass funnel—about 35 mm. diameter.
      Medium glass funnel—about 120 mm. diameter.
      Filter paper (e.g., Whatman No. 4) about 200 mm. diameter.
      Rubber tubing, about 3 inches long, about 6 mm. inside diameter.
      Clamp—screw type (Hofmann).
      Small scissors.
      Separatory funnel—about 100 cc. size.
      A few 5 cc. and 10 cc. pipettes.

B. Paper Chromatography:

A large test tube, about 150 mm. long and about 20 mm. in diameter, is fitted with a cork stopper into which has been placed at its smaller end a small wire hook (the hook can be made from a wire staple). A 70% (by

volume) alcohol-water solution is placed in the test tube up to a depth of about 15 mm. Narrow strips of filter paper, Whatman No. 1, about 6 mm. wide and long enough to reach from the wire hook down into the alcohol solution for about 5 to 10 mm. are prepared. Small holes are placed close to one end in order that the strips may be suspended on the hooks. About 15 mm. from the other end a heavy dot of ink is made (the ink from a Papermate ball-point pen has been found to be satisfactory since it contains three different colors). After the test tube is placed in a vertical position, a strip is hung from the wire hook, so as not to allow the strip to stick against the side of the tube. It will be noted that the alcohol solution rises in the paper by capillary action. After a half hour, separation of the components can be noted as colored bands at different levels on the paper strip.

1. *Materials:*
   a. A large test tube, about 150 mm. long and about 20 mm. in diameter.
   b. A cork stopper to fit the test tube into which is placed in its smaller end a fine wire hook.
   c. A 70% (by volume) alcohol-water solution—about 10 cc. Ethyl alcohol is preferred, but other alcohols, including rubbing alcohol should work.
   d. Filter paper, such as Whatman No. 1, cut into strips as described above. Whatman No. 4 paper and other filter papers will also work.
   e. Some colored substance containing different colored components, such as certain inks or stains.

C. Paper Electrophoresis:

1. *Preparation of the buffer solution:* One teaspoonful of ordinary table salt (5.25 grams of sodium chloride) and ¼ teaspoonful of baking soda (1.2 grams of sodium bicarbonate) are dissolved in 12 ounces (360 cc.) of tap water. The solution may be kept for several days. For an experiment using 200 volts the buffer solution is diluted 20 times. With lower voltage, less dilution may work better.
2. *Preparation of the filter paper:* Several strips of filter paper, Whatman No. 1, are cut about 50 mm. wide and about 320 mm. in length.
3. *Setting up the experiment:* A filter paper strip is moistened with the buffer solution and is placed between two plates of window glass, 2 inches by 8 inches, such that the ends of the strip extend beyond the glass plates approximately an equal distance at each end. The excess buffer solution is squeezed out by pressing the glass plates together. The glass plates are taken apart, and care is taken that the paper is not torn and that it lies on one of the plates smoothly. A line of ink (ink from a Papermate ball-point pen is satisfactory), about 1¼ inches long is drawn on the wet paper at right angles to the longer dimension of the paper approximately in the center of the paper strip, (be careful not to tear the paper!). The strip is again squeezed between the two plates and four spring-clip clothespins are placed near the corners of the glass plates to hold them together.

   The glass plates are placed between two flat dishes such that the edges of the dishes support the plates and allow the filter paper that extends beyond the ends of the plates to rest in the dishes. Buffer solution is then poured into each dish to a depth of at least 1 cm., but not closer to the rim of the dishes than about ¼ inch. The end of a graphite electrode (made by removing the central graphite rods from regular flashlight dry cell batteries) is placed in the solution in each dish and a current of about 10 milliamperes and a voltage of 200 volts is passed through the system. After about fifteen minutes different rates of migration of the components have produced colored bands on the paper strip (with the Papermate ball-point pen ink a yellow band has migrated ahead of a pink band toward the positive electrode; a neutral blue band has remained at the site of application of the ink line).

4. *Materials:*
   a. A few grams of table salt.
   b. A few grams of baking soda.
   c. Several sheets of filter paper, e.g., Whatman No. 1. Other types of filter paper, such as Whatman No. 4, or blotting paper will work as well.
   d. Two glass plates, 2 inches by 8 inches. Ordinary window glass may be used, or glass plates, ¼ inch thick, work well.
   e. Four spring-clip clothespins.
   f. Two flat glass dishes, such as small flat icebox dishes or Petri dishes.

g. A colored material containing different colored components, such as certain inks or stains.
h. Two graphite electrodes.
i. A direct current power supply, preferably with variable control providing up to 250 volts. Such power supplies can be purchased, but are somewhat expensive. A satisfactory one can be built from a kit for about $30 or from second hand parts obtained from a radio shop. Somewhat lower voltage can be employed if the undiluted buffer is used and/or if the experiment is run for a longer time, but the highest voltage possible without overheating is recommended.

See articles in *Scientific American*, Vol. *193*, pp. 92-98, Aug. 1955 and Vol. *191*, pp. 102-106, Feb. 1953.

GENETICS AND SKIN GRAFTING

By RICHMOND T. PREHN, M.D.
Laboratory of Biology, U. S. National Cancer Institute

Principles: Genetics, the study of hereditary factors in living organisms, constitutes one of the major areas of biological research. The differences among different animals of the same species can be used to study many of the hereditary factors operative in the group, and studies employing breeding experiments have been widely used for both theoretical and practical approaches. It is known that heredity plays an important role in certain diseases, and through breeding procedures strains of mice have been produced in which almost all the females will develop breast cancer. Conversely, other strains of mice have been produced in which the females show a very low incidence of breast cancer.

Another way of showing hereditary differences is through the use of skin grafting experiments. The animal body is able to detect, in a manner not too well understood, foreign cells when they are introduced into the animal, and processes occur that cause destruction of the foreign cells. Thus, when a surgeon treats a patient with a rather severe burn, he uses, if possible, skin grafts from other areas of the skin of that same patient. If a skin graft is made from another person the skin graft will not be permanently successful. An interesting exception is when the skin graft is made from one identical twin to his partner, for in this case the same hereditary make-up of the two subjects permits a successful operation. In mice a similar situation can be brought about through repeated inbreeding of the animals with the production of highly inbred strains. In animals of these strains the hereditary make-up from animal to animal is nearly enough alike to allow successful skin grafting from one individual to another.

Below is given the technique of skin grafting in mice, demonstrating its application in transplanting an area of skin in a single animal from one area to another and also in transplanting an area of skin from one animal to a different individual. Successful grafting should result in the first case, but not in the second unless the animals are both members of a highly inbred strain of mice. If inbred strains are available, the technique can be extended to include animals of this group.

Procedures: 1. Preparation of anesthesia (by teacher):

6.25 cc. Veterinary nembutal 6.25 cc. 70% ethyl alcohol Enough water to make a total volume of 50 cc.	mix well

(this is sufficient for approx. 200 mice)

2. Inject (using tuberculin syringe) into the peritoneal cavity of the abdomen of each mouse .01 cc. of anesthesia/gram body weight (approx. 0.25 cc. for average mouse). (Method of holding mouse must be demonstrated or all injections may be done by teacher).
3. Place paper towels over operating board.
4. When mice are asleep, fasten both animals in anatomical position (abdomen side down) by passing push pins through the webbing of the feet into the operating board.
5. Using a piece of cotton, wet the fur on the back with 70% alcohol or water.
6. Remove large rectangle of skin (approx. 1″ by 2″) from back of each mouse, using

scissors and forceps (keep instruments and fur wet to prevent adherence of hair). Place the removed pieces of skin in a flat dish.

7. Divide each rectangle of excised skin into two equally sized squares (one piece to be replaced on the animal of origin; the other transferred to the second mouse).
8. Replace in the excised skin squares on the mice in the following way: ½ the skin excised from mouse A on Mouse A; the other half on mouse B. ½ the skin from mouse B on mouse B; the other half on mouse A. (Keep notes, with diagrams, of the positions of the skin grafts).
9. Suture (sew) the skin squares into place using black thread. Tie corners first. Use interrupted sutures (not more than ¼ inch apart) so that if one lets go the rest will still hold. An effort should be made to keep cut hair out of the wound. (Do not bandage in any way).
10. Place animals in separate cages. Observe for 2 months.

Suggestions: If done by the students, it might be well to reduce the labor and time by working in pairs, each student tending to one of the paired mice. Approximately 30 min. of anesthesia is available. If the mouse appears to be waking before the work is complete, a further .10 cc. of anesthesia may be given intraperitoneally (it will not work subcutaneously), but this should be avoided as it will lead to death in some of the animals. Mixed anesthesia may be stored for several months in the ice box.

In this demonstration sterile technique is not necessary, but general cleanliness is desirable.

Materials:

1. Two adult laboratory mice (any pedigree or sex)
2. Veterinary nembutal 10% (Abbott Laboratories, Chicago, Ill.)
3. Ethyl alcohol 70%
4. Tuberculin syringe (1 to 5 cc. capacity) and a ¾ to 1 inch 20-gauge needle. (a school doctor or local physician should be able to help obtain these materials in items 1-4.)
5. Large (2"-3") straight sewing needle.
6. #40 black cotton thread.
7. 8 push pins (Moore Push Pin Co., Phila., Pa.) or thumb tacks.
8. Operating board (approx. 6 x 8 x ½ inch white pine) or any soft wood.
9. Paper towels.
10. Straight surgical scissors (2" or 3").
11. Small toothed forceps.
12. Absorbent cotton.
13. Small flat dish (a glass furniture coaster will do).

ENDOCRINOLOGY AND THE EFFECTS OF HORMONES

By DONALD SPENCER

Endocrinology Branch, U. S. National Cancer Institute

Principles: Endocrinology is the study of the endocrine or ductless glands of the body, and the following demonstration is designed to show simply how the secretions or products of these glands affect other parts of the body. It is easy to demonstrate that certain organs or tissues of the body depend upon these products (hormones) for their growth and maintenance. Two examples are given: comb growth and oviduct development in the immature male and female chicks, respectively.

Hormones are important in the causation, study, and treatment of cancer. It is well known, of course, that the frequency of occurrence of cancer in certain organs is different in the male than in the female. By removal of the gonads or by the administration of certain hormones, the growth of some tumors in the treated animals can be modified in a striking fashion. Through hormone administration the modification of results obtained in other areas of cancer research (such as radiation, nutrition, drug treatment, hereditary) have led to important advances in our understanding of the role played by the ductless glands in cancer. In certain types of cancer in man, hormone preparations have been very useful in helping the patient to live a comfortable and useful life beyond the time he could have lived had he not received hormonal therapy.

Procedures: Taking the comb growth example first, we can show that in order for the comb, which is a male secondary sex characteristic, to grow, a male

hormone such as testosterone, one of the hormones produced by the testis, is necessary. If we take six chicks, from one day to two weeks of age*, we can set up two groups of three each with one group being used for treatment and the other serving as a control. Testosterone or testosterone propionate in oil solution are the best hormones to work with, and the solution should be a concentration of about 10 mg./cc. If a 1.0 cc. syringe, graduated in divisions of at least 0.05 cc. is available, then the chicks can be injected just under the skin at the back of the neck with 0.1 cc. of the solution once daily for eight days. Or 0.1 cc. of the solution can be applied topically on the comb area with no needle being needed. If both syringes and needles are unobtainable, then an ordinary eyedropper can be employed to apply one or two drops of the solution on the comb area. This is a crude method but the end result will be just as striking—a tremendous increase in the size of the treated comb over the untreated one by the eighth day. In testing the potency of different hormones or different strengths of the same hormone a quantitative study can be made by cutting the combs off and weighing them. For a class demonstration, gross observation should suffice. An interesting sidelight of this test can be shown by using female chicks illustrating that male hormones can stimulate the female comb or other male secondary sex characteristics such as aggressiveness, just as they do in the male.

Our second example illustrates how the female hormones or synthetic estrogenic compounds stimulate the growth of the oviduct. We can again use six chicks, female this time, of course, one day to three weeks of age, divided into two groups of three each. A very potent synthetic hormone-like compound, diethylstilbestrol is the best to use in this case. It should be concentrated to 50 mg./cc. in oil solution, and 0.1 cc. of this solution is injected under the skin of the neck daily for eight days. In this test it is necessary to kill the animals to see the end results and this can be done by putting the chicks in a covered bucket or large jar in which some paper, saturated with chloroform has been placed. If no chloroform is available, the chicks can be killed quite humanely by breaking their necks quickly with whatever means at hand. After killing the chicks, the abdominal area is opened with a pair of scissors pushing the other organs aside to show the oviduct running from the cloaca upward toward the rib cage. It may be helpful to mention at this point that the oviduct of the chick corresponds to the fallopian tubes and uterus of the mammals or humans. As in the comb test it should be pointed out that for quantitative work the oviduct is removed and weighed but for class demonstration no extensive dissection is necessary since the extreme enlargement of the treated oviduct will be easily seen grossly by the eighth day.

Materials and Sources: *Chicks:* Chicks of any strain can be used. Sexed chicks can generally be obtained from most local hatcheries only in the early spring and summer.

Cages: Wire cages about two feet square and eight or more inches high are needed. A temperature of 95-98° F. should be maintained at all times. A 100-watt bulb with a metal reflector may be used.

Diet: Any standard chick feed such as Purina Startina can be used. This food and drinking water should be available to the chicks at all times.

Chemical: Hormones are not readily obtained, but the school doctor or a local physician should be able to help out on this. They could possibly have samples or if not, could provide the necessary prescription. Testosterone or testosterone propionate are generally available as an oil solution and can be diluted down to the concentration mentioned, with corn oil or olive oil, if necessary. Diethylstilbestrol is generally found in pill form and this means a little extra work. The pill is ground up in a mortar and dissolved in a small volume of ether and placed in a test tube. To this solution a portion of oil is added, and the two are mixed thoroughly. Then the tube is placed in a simple water bath, heated, and the ether driven off by evaporation leaving the hormone behind in the oil. This is best done under a hood as a safety precaution. After the oil has cooled, it can be poured into a graduate and more oil added until the concentration desired is reached. It is important to mix very carefully at this point.

Syringe and needles: These items again might necessitate the help of a physician. The syringe best suited for this work is the 1.0 cc. tuberculin type with graduations of 0.05 cc. Since the oil solutions are fairly heavy, the needles should be 22 or 23 gauge and about one inch long.

A listing of "Representative Sources for Supplies" for these experiments and demonstrations may be found on page 99 of the March, 1956 issue.

IN YOUR SERVICE—The work of Uncle Sam's Forest Rangers. U. S. Forest Service, Department of Agriculture, Washington 25, D. C. Single copies of this illustrated pamphlet and accompanying poster may be obtained by teachers without charge from the Office of Information at the above address. Additional copies at 20 cents from the Supt. of Documents, U. S. Government Printing Office.

* The one-day-old chicks are more difficult to obtain, but the one or two-week-old chicks work as well.

1956 Winners

SCIENCE ACHIEVEMENT AWARDS FOR STUDENTS

The 1955-56 program of Science Achievement Awards for Students attracted the largest response yet in the five-year history of this endeavor. About 2500 teachers requested and received over 23,000 sets of student entry forms and information. About 10 per cent of the students followed through with a completed entry. The regional judging teams identified 120 entries of sufficient merit to receive Regional Awards of U. S. Savings Bonds. Five 7th and 8th grade students in each region received $25 bonds, five 9th and 10th grade students received $50 bonds, and five 11th and 12th grade students received $75 in bonds. In addition, all received FSA gold pins and FSA certificates; their schools received FSA trophy case placques engraved with the names of the winning students.

Twenty special National Awards were given for projects that dealt with metals and metallurgy. These students received $100 U.S. Savings Bonds. Also, about 40 per cent of all entries received Honorable Mention certificates. In all, 988 students received awards and recognition in the 1956 program of Science Achievement Awards.

To help keep the program as effective as possible and in tune with what teachers and scientists want, plans and procedures were frequently presented to an Advisory Committee comprised of the following: Helen Hale, *Chairman*, Baltimore County Board of Education, Towson, Md.; Glenn Geil, U.S. National Bureau of Standards, Washington, D. C.; Harold Horn, Wheaton High School, Wheaton, Md.; Milton O. Lee, Federation of American Societies for Experimental Biology, Washington, D. C.; Edward Beach, Hyattsville Junior High School, Hyattsville, Md.; and Howard Owens, Northwestern High School, Hyattsville, Md.

Our nation needs increasing numbers of young people who know and appreciate the challenges and opportunities awaiting them in science. As we look to another year, we encourage boys and girls all over America to try their hands at some kind of science project. There are no greater satisfactions than those which come from creation, invention, and discovery.

The following listing includes the names of all students winning National Metals and Regional Awards. The student's name is followed by his or her grade, project title, school, and the name of the teacher sponsor. A complete listing including students who have won Honorable Mention is available on request from the NSTA office while the supply lasts.

Congratulations to all these students and their teachers; and our sincere thanks and appreciation for the vision, enthusiasm, and support of the American Society for Metals in making this program possible.—*The Executive Secretary.*

NATIONAL METALS AWARDS

Andre, Patricia (12): *The Mathematical Relations among the Axes and Axial Angles of Metallic Crystals;* South Side Sr. H. S., Rockville Centre, L. I., N. Y. **Esther Dahlberg.**

Azlen, John (12): *Effects of Quenching Media on Steels;* W. D. Lowe Vocational H. S., Windsor, Ontario, Canada. **L. F. McGee.**

Cestone, Frank (12): *Bismuth Resistance Thermometer;* Madison H. S., N. J. **Richard F. Mason.**

Dohne, Brian (11): *Electroplating;* Anacostia H. S., Washington, D. C. **Elaine Kilbourne.**

Epp, Helmut (10): *Application of Advanced Mathematics to Crystallography;* Evanston Township H. S., Ill. **M. B. Sailsbury.**

Gaither, Robert H. (12): *Crystal Habit and Growth;* Northwestern H. S., Hyattsville, Md. **Howard B. Owens.**

Goldberg, Stanley (12): *The Cadmium Sulfide Solar Battery;* Henry Grady H. S., Atlanta, Ga. **R. B. Belsar** and **Mary Asher.**

Gudan, Mary Ann (12): *Study of the Decalescence and Recalescence Zones of Steel;* Lorain H. S., Ohio. **Harold C. Freshwater.**

Haskins, Donald (12): *The Bell Solar Battery;* Anacostia H. S., Washington, D. C. **Elaine Kilbourne** and **Sophia R. Edwards.**

James, Philip (11): *Chemical Corrosion of Titanium and Aluminum;* Allentown H. S., Pa. **C. W. Gehris.**

Kestner, Neil (12): *Metallurgical Studies on Mn-Zn Ferrites;* Boys' Technical H. S., Milwaukee, Wis. **Jay W. Butts.**

LaForge, David (11): *Selective Etching of Iron and Nickel;* Palo Alto Sr. H. S., Calif. **Clyde E. Parrish.**

Luff, Kathryn Joy (12): *Continued Research on Aluminum as a Decorative Finish;* Notre Dame H. S., Moylan-Rose Valley, Pa. **Sister Catharine Virginia.**

Lux, Ann (12): *Suggested Industrial Uses for Titanium Alloys, Based on their Properties;* St. John Cathedral H. S., Paterson, N. J.

Radovich, Alex (12): *Factors Affecting Depth of Case in Pack Carburizing;* W. D. Lowe Vocational School, Windsor, Ontario, Canada. **L. F. McGee.**

Reichert, John D. (11): *An Attempt to Identify the Constituents of Common Alloys by Paper Chromatography;* Stephen F. Austin H. S., Austin, Tex. **Edna B. Boon.**

Rivas, Madeline (12): *The Metallurgy of Aluminum;* San Gabriel Mission H. S., Calif. **Sister Mary Clarice, O. P.**

Solomon, John Edward, Jr. (12): *Effects of Composition on the Thermal Curves of a Quaternary Alloy System of Cadmium, Lead, Tin, Bismuth;* Central H. S., Fountain City, Tenn. **Lula Mae Shipe.**

Stern, Richard (12): *An Experiment in the Electrodeposition of Copper on Iron Using a Chelating Agent;* T. A. Edison Vocational and Technical H. S., Elizabeth, N. J. **W. D. Pines.**

Stone, Allen (9): *Coefficient of Expansion of Metals;* Brittany Jr. H. S., University City, Mo. **Marshall Arky.**

REGIONAL AWARD WINNERS

Region I

(Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont)

Howard E. Norris, *Chairman*, The Loomis School, Windsor, Conn.

GRADES 7-8

Fox, Peter (8): *The Eye;* Canton Jr. H. S., Conn. **Nellie Shepard.**

Hanlon, Robert and **Webe, Allen** (8): *Effects of Radio Carbon Dating on the Geologic Time Chart with Special Reference to Attleboro, Mass. and Surrounding Communities;* Peter Thacher H. S., Attleboro, Mass. **Dorothy Mulroy.**

Kelly, John J. (7): *Soil Conservation;* West Warwick Jr. H. S., R. I. **Louise Archambault.**

Watts, Jack (7): *Ichthyology;* Weeks Jr. H. S., Newton Centre, Mass. **D. R. Foster.**

Wisner, George (8): *Electronic Brain Marvel of the Century;* Kennelly School, Hartford, Conn. **Randolph Gibson.**

Grades 9-10

Gilbern, Jane (9): *Proving the Mendelian Law;* Weeks Jr. H. S., Newton Centre, Mass. **Clifford Nelson.**

Rydell, Carl (10): *Experiments in Hyperspace;* Weston H. S., Mass. **Helen Green.**

Singer, William (9): *Red Giants, White Dwarfs, and the Russell Diagram;* Middlebrook Jr. H. S., Trumbull, Conn. **Thomas McCann.**

Stanley, Richard A. (9): *A Study of Electronic Oscillators;* Middlebrook Jr. H. S., Trumbull, Conn. **Thomas McCann.**

Wragg, Andrea (9): *Junior High School Students' Seating Requirements;* Weeks Jr. H. S., Newton Centre, Mass. **Clifford Nelson.**

GRADES 11-12

Beaudet, Paul R. (12): *Trigonometric Functions of Solid Angles;* St. Raphael Academy, Pawtucket, R. I. **Brother Austin.**

Hutchinson, Dorothy (11): *Spectroscopy;* Matignon H. S., Cambridge, Mass. **Sister M. Candida.**

Landry, John (12): *Color Vision of Fishes;* Rockville H. S., Conn. **Dorothy T. Harlow.**

L'Heareux, Conrad E. (12): *The Continuous Periodic Chart II;* St. John's Preparatory School, Danvers, Mass. **Brother Thaddeus, C. F. X.**

Shea, Geraldine M. (12): *Inhibition of Mouse Carcinoma by Use of Staph-Aureus, Tem and Mustargen;* St. Joseph H. S., Manchester, N. H. **Sister M. Beatrice.**

Region II

(New Jersey, New York, Pennsylvania)

Abraham Raskin, *Chairman*, Hunter College, New York, N. Y.

GRADES 7-8

Golden, Joseph (8): *Formation of Quicksand;* Long Beach Jr. H. S., Lido Beach, N. Y. **M. Bernice Maezer.**

Grey, Phyllis (8): *An Attempt to Set Up a Behavior Pattern for Certain Species of Tropical Fish;* Traphagen School, Mt. Vernon, N. Y. **Constantine Nickoll.**

Jennings, David (8): *A Study of Kibblehouse Quarry;* North Penn Joint H. S., Lansdale, Pa. **Lorraine Yavorek.**

Lizzi, Joseph (8): *Effects of Stimuli on the Amoeba;* Cathedral Academy, Albany, N. Y. **Sister Mary Agatha.**

Toffer, Annika (7): *Why Popcorn Pops;* Central Jr. H. S., Allentown, Pa. **Margaret Tiffany.**

Grades 9-10

Agrati, Guy (9): *Cholesterol and Its Relation to Athermatomous Lesions;* Thomas Jefferson Jr. H. S., Fair Lawn, N. J. **Elliot C. Kigner.**

Cantrell, Cyrus D., III (10): *An Algebraic Theorem;* Ithaca H. S., N. Y. **Lawrence E. Bach.**

Galavotti, Elvira (10): *Living Death;* Canastota H. S., N. Y. **Madeline Snyder.**

Klapholz, Henry (10): *A Mechanical Man With a Memory;* Bronx H. S. of Science, N. Y. **Frank Skutelsky.**

Tenenbaum, Joel (10): *Binary Computer;* Martin Van Buren H. S., Queens Village, N. Y. **Joseph Catska.**

Weinberg, Eric (9): *Weather and Weather Predicting;* Creston Jr. H. S., N. Y. **Paul Kahen.**

GRADES 11-12

Thomsen, David (11): *TTTA: A Tic-Tat-Toe Analyzer;* Atlantic City H. S., N. J. **Elma C. McConnell.**

Allen, James (12): *Nuclear Radiations;* Central Catholic H. S., Allentown, Pa. **Sister M. Christopher.**

Edlund, Anita (12): *Oligodynamic Action of Metals and Their Compounds;* Kenmore Sr. H. S., N. Y. **Louise Schwabe.**

Mason, Rodney (12): *Converting Light into Electricity with the "V" Antenna;* Chaminade H. S., Mineola, N. Y. **Brother George Sphan.**

Slaton, Stephen (12): *A Study of Reaction Time in Man;* Forest Hills H. S., N. Y. **Harvey Pollack.**

Worms, Helen (12): *Quantitative Analysis of Factors Affecting the Growth of the Grown-Gall Tumor;* Hunter College H. S., N. Y. **Leona Adler.**

Region III

(Delaware, District of Columbia, Kentucky, Maryland, North Carolina, Tennessee, Virginia, West Virginia)

Robert T. Lagemann, *Chairman*, Vanderbilt University, Nashville, Tenn.

GRADES 7-8

Boltt, Steven (8): *Principles of Color;* Leland Jr. H. S., Chevy Chase, Md. **Anita Bickford.**

Briggs, Cathy (8): *Protein Deficiency in Chicks;* Leland Jr. H. S., Chevy Chase, Md. **Anita Bickford.**

Frank, Kathleen (8): *Are Rats Color Blind?;* Leland Jr. H. S., Chevy Chase, Md. **Anita Bickford.**

Lady, Kenneth (8): *Volt Ohm Meter;* Takoma Park Jr. H. S., Silver Spring, Md. **Ella B. Lopez.**

Vacher, Leonard (7): *Geology of Lassen Peak and Vicinity;* Gordon Jr. H. S., Washington, D. C. **M. M. Johnson.**

Grades 9-10

Armsby, Richard E. (9): *Tests of the Learning and Memory Ability of the Albino Rat;* Alice Deal Jr. H. S., Washington, D. C. **Ida Hill.**

Ganz, Edward (9): *Symbolic Logic, Boolean Algebra and Electrical Circuits;* Kramer Jr. H. S., Washington, D. C. **Stephan Hopkins.**

Heiges, Lynwood, Jr. (9): *Listen to the Sun, Moon, and Stars!;* Paul Jr. H. S., Washington, D. C. **Berenice G. Lamberton.**

Rice, Jerry M. (10): *The Fractionation of Blood Plasma;* Anacostia Sr. H. S., Washington, D. C. **Elaine Kilbourne.**

Wallace, Betty Lou (9): *Steps in Entomology;* Mt. Park H. S., N. C. **Lottie M. Wallace.**

GRADES 11-12

Armsby, Robert (12): *Calorimetric Measurement of the Metabolic Rate of the Albino Rat as Affected by Diet;* Sanford Preparatory School, Hockessin, Dela. **Nancy Sawin.**

Gaither, Robert H. (12): *Crystal Habit and Growth;* Northwestern H. S., Hyattsville, Md. **Howard B. Owens.**

Hyman, Murray H. (11): *APC Virus Quantification in Hela Cells;* Baltimore City College H. S., Md. **Bernard Roizman.**

Larson, Robert (12): *The Design and Construction of a New Type of Binary Multiplier-Translator;* Oak Ridge H. S., Tenn. **Paul Shank.**

Preston, John (12): *Radioactivity and the Physiology of Plants;* Archmere Academy, Claymont, Dela. **Rev. Bernard Brunette, O. P.**

Region IV

(Alabama, Arkansas, Canal Zone, Florida, Georgia, Louisiana, Mississippi, Puerto Rico, South Carolina)
Katherine Hertzka, *Chairman,* Hoke Smith High School, Atlanta, Ga.

GRADES 7-8

Ellis III, Tellis B. (7): *A Comparative Study of Animal Hair—Common and Uncommon;* Jackson College Laboratory, Miss. **Cleopatra D. Thompson.**

McMahon, Amanda (7): *Where Bacteria Are Found;* Bailey Jr. H. S., Jackson, Miss. **James K. Upchurch.**

Murray, Neta (7): *Age of Reptiles;* Hand Jr. H. S., Columbia, S. C. **Nelle H. Mulligan.**

Thomas, Alice (8): *Artesian Well;* Hand Jr. H. S., Columbia, S. C. **Nelle H. Mulligan.**

Upchurch, James (7): *Solar Engine;* Bailey Jr. H. S., Jackson, Miss. **Nancy Lay.**

Grades 9-10

Dunson, William A. (9): *Surface Tension Estimation of Quaternary Biocides;* Northside H. S., Atlanta, Ga. **Julia Newton.**

Klingberg, Robert (10): *The Electrostatic Generator;* North Miami H. S., Fla. **Perry Farmer.**

Pestcoe, Allan (10): *The Effects of Herbicides Upon the Absorption of Sulfur by Plants;* Miami Beach Sr. H. S., Fla. **Lois Allsworth.**

Preger, Robert (10): *Uptake of Radio-Phosphorus in Bean Plants;* Miami Beach Sr. H. S., Fla. **Elizabeth E. Ferguson.**

Thomas, Jr., Clarence (10): *The Life History of the Frog and Dissection of the Adult Frog;* Sidney Lanier H. S., Montgomery, Ala. **Marie Barnes.**

GRADES 11-12

Brown, Jerry (12): *The Carcinostatic Action of Hydrocarbons;* Greenville Sr. H. S., S. C. **Nellie Burnette.**

Diesen, Bernie C. (11): *Friends and Foes of the Insect World;* North Miami Sr. H. S., Fla. **H. Quincy.**

Goldberg, Stanley (12): *The Cadmium Sulfide Solar Battery;* Grady H. S., Atlanta, Ga. **R. B. Belsar** and **Mary Asher.**

Johnston, Kenneth (12): *Jet Propulsion;* Jordan H. S., Columbus, Ga.

Venable, John Jr. (12): *Photoelastic Stress Analysis in Liquids;* Northside H. S., Atlanta, Ga. **Julia Newton.**

Region V

(Illinois, Indiana, Michigan, Ohio)
Walter E. Hauswald, *Chairman,* Sycamore Community High School, Ill.

GRADES 7-8

Chanowitz, Michael (8): *The Spectrometer;* Haven School, Evanston, Ill. **Louise Holleweg.**

Hill, John R. (8): *Methods of Fixation for Fractures;* Hawken School, Cleveland, Ohio. **Byron Williams.**

Kaan, Mary (8): *The Frog;* Haven Jr. H. S., Evanston, Ill. **Alfred Lazow.**

Lang, John (8): *Static Electricity;* Hawken School, Cleveland, Ohio. **Byron Williams.**

West, Sybel (8): *Fractional Distillation of Petroleum;* Haven Jr. H. S., Evanston, Ill. **Louise Holleweg.**

Grades 9-10

Bell, Judy (9): *Effect of Detergents on Materials;* Aquinas H. S., Chicago, Ill. **Sister John Maureen, O. P.**

Burns, Stephen (10): *How to Eliminate the Mechanical Limitations of Sound Reproduction;* Romeo H. S., Mich. **Rudolph Kamischke.**

Epp, Helmut (10): *Application of Advanced Mathematics to Crystallography;* Evanston Township H. S., Ill. **M. B. Sailsbury.**

Knight, Peter (10): *The Effects of Prolonged Low Temperature on Asperigillus Niger;* University School, Shaker Heights, Ohio. **John R. Baker.**

Rose, Nell (10): *Influence of Protein Source on Growth;* Lyons Township School, LaGrange, Ill. **Robert Stiger.**

GRADES 11-12

Clark, John B. (12): *Synthesis of an Improved Polyester Embedding Resin;* Sycamore Community H. S., Ill. **Walter E. Hauswald.**

Dickson, Sandra (12): *A Search for Methods of Producing Perfume Components Using Biosynthesis;* Evanston Township H. S., Ill. **M. B. Sailsbury.**

Geary, N. Hugh (12): *Theorem of Group Linkage;* Ambia Public School, Ind. **Alton D. Andrews.**

Gudan, Mary Ann (12): *A Study of the Decalescence and Recalescence Zones of Steel;* Lorain H. S., Ohio. **Harold C. Freshwater.**

Lapp, Douglas M. (12): *A Study of Cavitation in High-Power Ultrasonics;* Springfield H. S., Ill. **Roy A. Deffenbaugh.**

Region VI

(Canada, Iowa, Minnesota, Montana, Nebraska, North Dakota, South Dakota, Wisconsin, Wyoming)
James A. Rutledge, *Chairman,* University of Nebraska, Lincoln.

GRADES 7-8

Crossley, Kent B. (8): *An Atomic Nuclear Power Plant;* Faribault H. S., Minn. **Clinton Knudson.**

Hulick, Timothy (8): *A Transistorized A. F.-R. F. Signal Tracer and Signal Generator;* St. Joseph School, La Crosse, Wis. **Sister M. Theola.**

Kelsey, Tom (8): *Repulsion Coil;* Torrington Jr. H. S., Wyo. **Estner Michel.**

Leverenz, Barbara (8): *How to Make Your Own Teenage Long-lasting Lipstick;* U. S. Grant School, Sheboygan, Wis. **Walter Lartz.**

Redman, Wayne (8): *Self-propelled Model Riverboat;* Torrington Jr. H. S., Wyo. **R. Everett Michel.**

Grades 9-10

Banasik, Judith (9): *How to Make Figures Speak;* Aquinas H. S., La Crosse, Wis. **Sister M. Theodorita.**

Boehm, Lynn (10): *Nutrition of Rats;* Aquinas H. S., La Crosse, Wis. **Sister M. Thomasetto, F.S.P.A.**

Gruber, Loren (9): *The Effects of Antibiotics on Bacteria;* Junior-Senior H. S., Sac City, Iowa. **Warren Wallinga.**

Gschwind, Jerry (10): *Applications of Geometry;* Aquinas H. S., La Crosse, Wis. **Sister M. Petrella.**

Speltz, Peter (10): *Calorie to Kilowatt;* Cotter H. S., Winona, Minn. **Sister M. Bibiana.**

GRADES 11-12

Chapman, Robert (12): *Construction and Use of a Radio-Frequency Titrimeter;* Fort Dodge High School, Iowa. **Elvin Chapman.**

Kelley, Milferd, Jr. (11): *The Effects of X-rays on Daphnia Pulex;* Cedar Falls H. S., Iowa. **Anton Hofstad.**

Kestner, Neil (12): *Metallurgical Studies on Mn-Zn Ferrites;* Boys' Technical High School, Milwaukee, Wis. **Jay W. Butts.**

Lane, Richard (12): *Construction and Use of Electrophoresis Apparatus;* Cheyenne Sr. H. S., Wyo. **Glenn Rogers.**

Verwald, Aloysius (12): *The Effect of Tiling on Soil Yields;* Xavier H. S., Dyersville, Iowa. **Sister Mary Cecilia, O.S.F.**

Region VII

(Colorado, Kansas, Missouri, New Mexico, Oklahoma, Texas)

Stanley B. Brown, *Chairman,* University of Colorado, Boulder.

GRADES 7-8

Bartlett, Paul, Jr. (8): *The Snakes of the Sabine Area;* Woodrow Wilson Jr. H. S., Port Arthur, Tex. **Lorena B. Hall.**

Gerrietts, Margaret (8): *The Survey of the Growth and Habits of a Pigeon;* Woodrow Wilson Jr. H. S., Port Arthur, Tex. **Mary Hirsch.**

Kelsey, Leland (8): *Scientific Apparatus;* Center Consolidated School, Colo. **Leonard H. Pratt.**

Pullen, Jack (8): *Making Telescope and Photographing Moon Through It;* Woodrow Wilson Jr. H. S., Port Arthur, Tex. **Lorena B. Hall.**

Schexenider, Beverly (8): *Effects of Minerals on Plants;* Woodrow Wilson Jr. H. S., Port Arthur, Tex. **Lorena B. Hall.**

Grades 9-10

Frank, Robert, E. (9): *Bird Study (Scientific);* Norman Jr. H. S., Okla. **Vivla Johnson.**

Hollis, Ralph (9): *Rocket;* Charles Curtis Intermediate School, Wichita, Kans. **Joseph Foraker.**

Jones, Judith (9): *A Study of Ultraviolet Rays;* Roosevelt Jr. H. S., Coffeyville, Kans. **Jennie K. Macoubrie.**

Mahon, Michael J. (9): *Electrical Determination of Hydrogen Ion Concentration;* St. Louis Univ. H. S., Mo. **Charles T. Conway.**

Shown, Joanne M. (10): *Recording of Physiological Phenomenon of Heart Rates and Muscle-Nerve Preparations;* Center H. S., Colo. **Leonard H. Pratt.**

GRADES 11-12

Bridson, William E. and **Michaelsen, Russell A.** (11): *A Study of the Effects of the Growth Hormone on Guinea Pigs;* Wichita H. S. East, Kans. **Gerald D. Tague.**

Dunn, Kenneth (12): *Phono-Vision (Television Telephone);* Central H. S., Oklahoma City, Okla. **Clarance Deal.**

Martin, Harold (12): *A Preliminary Report of an Agricultural Soil Analysis of the San Luis Valley, Colorado;* Center Consolidated H. S., Colo. **Leonard H. Pratt.**

Reichert, John D. (11): *An Attempt to Identify the Constituents of Common Alloys by Paper Chromatography;* Stephen F. Austin H. S., Austin, Tex. **Edna Boon.**

Salser, Winston (11): *A Study of the Effects of X-Radiation on Plants and Animals;* Wichita H. S. East, Kans. **Gerald Tague.**

Region VIII

(Alaska, Arizona, California, Hawaii, Idaho, Nevada, Oregon, Utah, Washington)

Gertrude W. Cavins, *Chairman,* San Jose State College, Calif.

GRADES 7-8

Barklow, Tommy (8): *Ion Exchange;* Elma H. S., Wash. **Theodore Jeffries.**

Connell, Glenda (7): *Do Plants Use Minerals?;* Woodrow Wilson School, Oakland, Calif. **Maurice Phelan.**

Gilkeson, Susan (8): *Dietary and Nutritional Factors at Work;* LaCumbre Jr. H. S., Santa Barbara, Calif. **Lawrence Cudney.**

Greisel, Larry (8): *Stroboscope;* East Gresham Grade School, Gresham, Ore. **Irma Greisel.**

Leslie, Carol (8): *Tropisms, Man's Best Friend;* LaCumbre Jr. H. S., Santa Barbara, Calif. **Lawrence Cudney.**

Grades 9-10

Hartman, Buz (10): *Improving the Electrical Contacts for a Self-playing Electronic Music Box;* Corvallis H. S., Ore. **Richard F. Thaw.**

Mason, John (10): *A Comparative Study of the Effects of Shock on Various Structural Designs;* George Washington H. S., San Francisco, Calif. **John J. Burke.**

Michael, Frances (10): *The Study of the Response of Earthworms to Various Stimuli;* George Washington H. S., San Francisco, Calif. **John J. Burke.**

Nininger, Neil (10): *An Instrument for Determining the Mass of Atoms: A Mass Spectrograph;* Tamalpais H. S., Mill Valley, Calif. **Richard L. Lehman.**

Tetley, Richard (10): *Do Species of Flatworms Other Than Planaria Regenerate?;* Carmel H. S., Calif. **Enid A. Larson.**

GRADES 11-12

Alstatt, Daniel J. (12): *An Experimental Investigation of the Flight of the Flying 'Lawn Mower' As Effected by the Vertical Movement of the Center of Pressure, Center of Lateral Area, Center of Gravity and a Variation of Coning Angle;* Sacramento Sr. H. S., Calif. **Oliver A. Livoni.**

Gates, Gerald O. (12): *Studies in Herpetology of the Southwest;* Wickenburg H. S., Ariz. **Jack Fishleder.**

LaForge, David (11): *Selective Etching of Iron and Nickel;* Palo Alto Sr. H. S., Calif. **Clyde E. Parrish.**

Moore, Julie (11): *Effects of X-ray Radiation on Guppies;* Grants Pass H. S., Ore. **Leslie Weigart.**

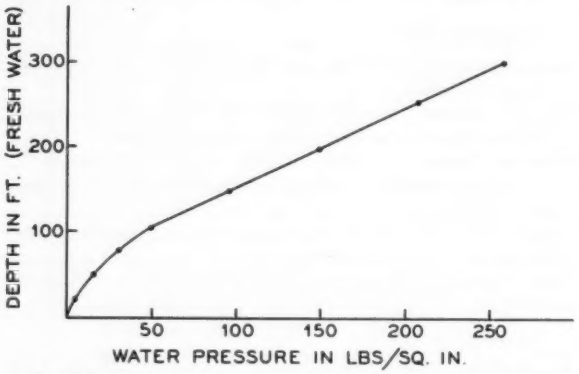
Nebert, Daniel (12): *To Study the Regenerative Powers of the Local Earthworm;* Beaverton H. S., Ore. **Mike Fiasca.**

ANGELL—continued from page 178.

Subject-matter area: Meteorology
Concept: Water cycle
Ability: To suggest or screen hypotheses

4. The Weather Bureau in a nearby city has predicted that within 5 years after completion of the dam the average yearly relative humidity will have increased markedly. This increase might be due to all of the following EXCEPT
   (A) transpiration from nearby field-crop plants
   (B) evaporation from the man-made lake
   (C) evaporation from irrigated soil
   (D) evaporation from the excess water overflowing from the dam

Subject-matter area: Physics
Concept: Hydrostatics
Ability: To interpret data and draw conclusions



5. The above data were obtained during the summer from Lake Melville which is 20 miles shorter in length but approximately the same depth at the dam as the proposed design. Lake Melville is located in a nearby region. On the basis of the data given, which of the following conclusions is correct?
   (A) The pressure exerted by a liquid varies directly as the depth.
   (B) The water near the surface of Lake Melville is warmer than the water below.
   (C) The graph would be a straight line if the measurements had been accurately made.
   (D) The length of the lake affected the pressure at the surface but not at the bottom.

Subject-matter area: Biology
Concept: Photosynthesis
Ability: To suggest or screen hypotheses

6. Green aquatic plants growing at the bottom of the river will be covered over with 300 feet of lake water. They will probably die due to
   (A) lack of light
   (B) lack of mineral salts
   (C) lack of oxygen
   (D) excessive water pressure

In the first set, the situation as posed in the two-sentence introductory statement is clearly an economic aspect of science within the problem area of conservation. The first question was designed to measure the student's understanding of the functions of vegetation in minimizing erosion and also his ability to interpret data and draw conclusions. The second question was written to measure the student's understanding of the role of fertilizers in plant development together with his ability to evaluate critically the claims or statements of others. The third question was written to measure the student's understanding of the principles of adequate sampling techniques and also his ability to select validating procedures. The fourth question was written to measure the student's understanding of one of the basic principles of crop rotation and his ability to screen hypotheses. While it is true that most of us could read and answer these questions with little, if any, critical thought processes—in fact, in most cases, we would answer these on a factual recall basis—it is thought that the junior high school student will not be able to do this and in most cases must answer the questions through the use of some basic information plus application of the problem-solving abilities.

The second set of materials was especially written for the purpose of illustrating to the members of the workshop the test design envisioned by the original panel. While the junior high school set we have just examined contains items measuring almost exclusively in the area of biology, the set we are about to consider was particularly designed to cover a wide range of subject-matter areas, concepts, and abilities; in some cases, it may appear that one or more of the items have been "drawn in by the heels" but it must be borne in mind that this particular set was especially written to illustrate the range of subject matter, concepts, and abilities which might possibly be drawn in to an appropriate situation. The problem situation is clearly conservation and certainly falls within the economic aspect of science. The first item, on the face of it, is certainly measuring the student's ability to identify a scientific problem and in order to understand this problem the student must have some understanding of the practical results of diastrophism, although it is certainly not necessary either that he know the term diastrophism as such, or that he even understand the process of diastrophism. The other five questions are also quite clearly written to measure the abilities and concepts noted for each.

To those of us who designed and wrote these tests, it seems that this is the desirable direction in

which measurement should proceed: paralleling the best teaching practices and measuring the development of the critical skills and abilities as taught by the most capable teachers.

The main points of this paper can perhaps be summarized in the following statements:

1. Measurement, one phase of evaluation, is an integral part of effective teaching, and enables the teacher more accurately to appraise the student's educational status, his educational potentialities, his interests, and the teacher's own effectiveness.
2. Tests, both teacher-made and standardized, can be constructed to measure the outcomes of "abilities teaching." Such tests should be based upon a clear and explicit statement of purpose and objectives and test questions should be carefully written to fit these specific objectives.

Star Awards for Science Teachers

Do you expect to have a few hours to spare this summer?

A few summer hours, wisely spent, may very well result in a financial reward or in a form of professional recognition for you.

NSTA, as you may know by this time, is sponsoring the 1956 Science Teacher Achievement Recognition (STAR) program. This program is intended to encourage the reporting and dissemination of outstanding science teaching ideas.

Your entry can be a report of any one of a number of ideas. Here are a few suggestions:

An assembly program designed to attract more students into science courses or careers

A new laboratory exercise for a science class

An educational program planned and executed jointly by your school and a local community health agency

A new instructional unit for a science course

A new idea in extra-curricular or co-curricular science education

If you want more suggestions, write for the kit of materials that is sent to all prospective STAR entrants. You will find a clip-and-mail coupon for obtaining the kit in the center insert of *The Science Teacher* for March, 1956. The description of ten demonstrations performed by members of the National Cancer Institute for visiting high school science teachers should also be of help to those looking for STAR entry ideas. The demonstrations are described in the March, April and May issues of *The Science Teacher*.

Send the STAR clip-and-mail coupon to NSTA today. Use a few hours this summer to lay out and plan an idea that you can test in class next fall.

ABRAHAM RASKIN
Secretary-Editor, STAR

FIFTY-YEAR SCIENCE TEACHER HONORED BY CHEMICAL INDUSTRY

WASHINGTON POST PHOTO

IN 1906, King Edward VII was on the British throne, Theodore Roosevelt was in the White House, the panic of 1907 was a year away, and a young undergraduate at George Washington University in Washington, D. C., began teaching chemistry in the District of Columbia school system, continuing his own studies at night.

This year, Allen J. Marsh, chemistry instructor at McKinley High School, completed a half century of teaching in the same school. He has taught more than 6,000 students the fundamentals of science and, as one colleague puts it, "he's a better teacher today than he ever was."

Modest, retiring Allen Marsh was a little surprised when the Washington newspapers ran feature stories on his anniversary and was still more surprised when the chemical industry honored him with a testimonial luncheon on April 23.

The luncheon, sponsored by the Washington Chemical Progress Week Committee, was attended by over 150 prominent government, industry, military and education figures, including members of the Congress. Mr. Marsh's fellow chemistry teachers in surrounding communities were also in attendance.

In his testimonial remarks, General J. E. Hull USA (Ret.), President of the Manufacturing Chemists' Association, congratulated Mr. Marsh on his "dedicated work and splendid achievement" and took that occasion to remind his audience of the "indispensable role played by the dedicated men and women who teach the sciences to the citizens of tomorrow." The MCA, principal trade association for the chemical industry, has been active for some time in the field of industry-education cooperation.

Mr. Marsh will continue to teach through the next school year. When originally asked if any ceremonies would mark his golden anniversary in teaching, Mr. Marsh replied, "No, I have my hands full teaching 125 students."

Because of retirement regulations, it is doubtful if we will see many more science teachers celebrating a half century of teaching.

Mr. Marsh is a member of NSTA and served as head of the Department of Science Instruction of the NEA, one of NSTA's ancestors, during the 1927-28 school year.

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This unit is, of course, but one factor in the Total Experience Science Laboratory as conceived by Sheldon according to educationally correct principles. Cabinets, tables, and other furniture units are integrated into a science department which enables the instructor to give apt students the intensive training they require for science careers — without neglecting other boys and girls who must have a thorough indoctrination in science to lead better adjusted adult lives.

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Classroom Ideas

Elementary

Magnetic Lines of Force

By NICHOLAS M. BABYOCK, Latimer Junior High School, Pittsburgh, Pennsylvania

An exhibit of the effects of magnets on iron particles can easily be constructed in the ordinary classroom or laboratory. However, at times one may become somewhat annoyed, especially when a beautiful arrangement of iron particles becomes disturbed with the removal of the magnets. It is quite simple to overcome this by arranging the magnets in any desired manner underneath the drawing paper, usually 11 x 15 inches. After the iron particles are sieved out on the drawing paper, they are sprayed with a clear lacquer, air-dried, and resprayed several times depending on the volume of spray applied on each application. (*Caution:* Keep flames away; follow precautions on label.) After the final spraying and drying, the magnets can be removed without any disturbance of the iron particles. These exhibits can then be hung or stored for future use. It is quite apparent that with just one set of magnets it is possible to have several permanent exhibits at the same time.

Physical Science

Student Reaction to Laboratory Work in Physical Science

By GLENN F. POWERS, Arkansas State Teachers College, Conway

An attempt was made during the school year 1953-1954 at Arkansas State Teachers College to introduce laboratory work into the general education physical science course. It was felt that a summary of the students' reactions to laboratory work in such a course might prove of benefit, especially since some students are inhibited against laboratory work to the extent of actually fearing it.

The physical science for general education course is a four-hour course for non-science majors. Principles of elementary physics, chemistry, and astronomy are covered. No formal laboratory period is designated, but when the class interest happens to center around some particular principle that can be clarified by an appropriate laboratory experiment (a better term might be "experience") the class meets in the physics laboratory. Students work either individually or in pairs. Even though the laboratory program is informal and not restricted to a rigid schedule of particular experiments that must be performed, students are required to make a report of the experience. The following outline is suggested:

I. PURPOSE: (This is a rather formal statement of their objective and will be almost identical for all papers.)

II. APPARATUS: (A brief listing of equipment used accompanied by a drawing if needed; this will also be quite similar for each report. Despite some justifiable criticism, the author feels this is worthwhile.)

III. PROCEDURE: (Each student explains briefly what was accomplished or attempted, and how.)

IV. COMMENT AND CRITICISM: (In this section the student is assured that his remarks will not count *for* or *against* him. Every effort is made to obtain comments that will aid in future planning of laboratory work. The purpose of this paper is to summarize the consensus of student opinion.)

V. CONCLUSION: (This is a brief statement that should tie in with the purpose of the experiment. For example, if the purpose was to determine the number of centimeters in one inch, the conclusion would simply be a statement such as, *"My results indicate that there are 2.54 centimeters in one inch."*)

Four separate classes have been making reports in this manner during the past school year. A study of the "Comment and Criticism" portion of all of these experiments yields the following general impressions:

1. *Give us time.* As might be anticipated, students who take this type of science course do not utilize their time in laboratory as efficiently as science majors. Laboratory work is performed during the regular fifty-minute lecture period, and apparently if more than one or two simple procedures are entailed, the students feel that they are hopelessly short of time.

2. *Prepare us.* This opinion was voiced more at the first of each semester than later. These students

have widely varying backgrounds and sometimes even repeating the instructions several times is not sufficient. For example, prior to using meter sticks for the first time, the meter sticks were distributed during the regular lecture on metric units and discussed in detail. Emphasis was placed on how to estimate to tenths of a millimeter. This same practice was followed for each of the four sections during the year and yet at least one student (and often more) in each class would express amazement at being expected to estimate to tenths of a millimeter despite the fact that this had been explained repeatedly.

3. *Surprise us.* Almost as strong as the suggestion for *more* explanation was the request for less! A satisfyingly large number of students wanted to experience for themselves "the thrill of discovery." These students complained that detailed instructions spoiled the fun of experimenting.

4. *Give us more!* Most gratifying was the fact that although at the beginning of the course the opinion was preponderantly negative regarding laboratory work, by the end of the course students were clamoring for more time in the laboratory. Many expressed the opinion that the laboratory experiences had proved to be a very definite learning process and greatly increased the value of the course.

It was interesting to learn the differences in attitude on the part of the students. A music major, for example, in the experiment for determining the velocity of sound by a resonance tube and tuning fork of known frequency, commented that the best part of the whole experiment was the beauty of the resonance tone of the 288 v.p.s. fork!

From a study of these opinions, it would seem that these students prefer laboratory work to straight lecture-demonstrations in this type of course.

General

Evaluation Sheet for a Student Science Project*

By MADELEINE F. COUTANT,
New York State Education Department, Albany

Instructions: Each item may receive 0, 1, or 2 points. Mark 0 in the blank at the right if the answer to the question is "no," mark 1 for one partially satisfactory, and 2 for a satisfactory answer.

* Presented at the NSTA Winter Meeting, Atlanta, Georgia, December, 1955.

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When a question does not apply to the project being judged, mark X in the blank.

If the answer to the question is not apparent in the student's paper or in his demonstration, it may be obtained by interviewing the student.

1. Has the student shown originality in the selection of his project? Did the idea originate in his own thinking? ..... (1)_____
2. Does he have the problem clearly in mind? Has he attacked only as much of it as he can conceivably handle? ..... (2)_____
3. Does he know and appreciate the history of the problem? ..... (3)_____
4. Is he familiar with relevant facts, theories, and experiments? ..... (4)_____
5. Is his attempt to solve the problem original with him even if it is not truly original in the scientific sense? ..... (5)_____
6. Is his thinking logical? ..... (6)_____
7. Did he show ingenuity and resourcefulness in improvising methods or equipment or in overcoming other obstacles? ..... (7)_____
8. Does he draw only those conclusions supported by the data? ..... (8)_____
9. Does he view his own project critically? .. (9)_____
10. Does he distinguish between items of first and secondary importance? Between the significant and the insignificant? ..... (10)_____
11. Does he suggest ways and means to further extend the project? Do any of the suggestions show originality and imagination? ..... (11)_____
12. Has he presented the project in a professional manner including the record of data at the time it was obtained, and a carefully documented "paper"? ..... (12)_____

Total Points _____

Total Possible Points _____

Percent _____

General

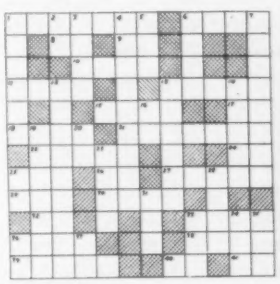
Science Crossword Puzzle

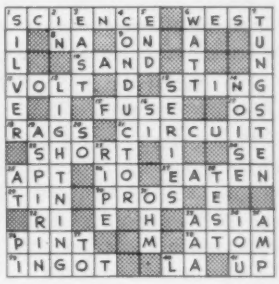
By MELVA M. HANEY, Thornton Township High School, Harvey, Illinois

This puzzle was made to be used with a unit on electricity so as many words as possible were included from that field. It has been quite effective in many of our freshman science classes.

ACROSS:

1. Classified knowledge
6. Direction on your left as you face north
8. Abbreviation for North America
9. In contact with the upper part
10. Chief ingredient of glass
11. Unit of electrical pressure
13. A bee's best weapon
15. Protects wires from an overload of current
17. Latin word for bone
18. Worn out clothes
21. The complete path of an electric current
22. May be caused by two bare wires touching each other
24. Abbreviation for southeast
25. Suitable
26. A moth with a round spot on each hind wing
27. Eat, ate, have .....
29. A silvery white metal
30. Professionals
32. Abbreviation for Rhode Island
33. Largest of the continents
36. Half a quart
38. Smallest part of an element
39. Cast for molding metal
40. Abbreviation for Louisiana
41. Not down





DOWN:

1. A metal that is a very good conductor of electricity
2. Not out
3. Direction on your right as you face north
4. Substance that can transmit an electric current
5. Finish
6. Unit of electrical power
7. Material used for light bulb filaments
12. Benjamin Franklin experimented with this form of electricity
13. Kind of electric circuit in which all the current flows through all parts of the circuit
14. Discordant or unpleasant sound
16. Spanish for "yes"
19. Acetyl salicylic acid
20. For this reason
23. Condition of fruit when ready to eat
25. In a place
28. A prospect of this encourages study
31. Unit of electrical resistance
33. Abbreviation for American Automobile Association
34. Written acknowledgment of a debt
35. Unit of strength of an electric current (brief form of word)
36. π
37. Toward

NSTA Activities

The Oregon Trail

Yes, many if not all "trails" will lead to Oregon this summer for hundreds of science teachers. First on the schedule will be the Third Annual West Coast Summer Conference, June 17-30 at Oregon State College. Thirty-two science teachers in the seven West Coast states have been selected to receive Crown Zellerbach Fellowships of $200 each to enable them to participate in the Conference. Their "report to the profession" on suggestions for making student projects stepping stones to careers in science will appear in an issue of *TST* next fall.

The annual business meeting of the NSTA Board of Directors will follow on June 30-July 1.

Then comes the big event which all science teachers within range can attend—the annual Summer Conference of NSTA. This will be held at Oregon State College July 2 and 3. Following are details of the program which has been arranged by a committee under the chairmanship of Dr. Stanley E. Williamson.

THEME: AROUSING INTEREST IN SCIENCE

Monday, July 2

8:30 a.m. Registration

9:00 a.m. General Session
Keynote Address: "This Magical Age"

10:00 a.m. General Session
"Science Fairs as an Aid in Teaching"

11:00 a.m. General Session
"Teaching for Problem Solving"

1:30 p.m. Concurrent Sessions—Biological and Physical Science
Special Experiments, Projects, and Demonstrations to Arouse Interest in Science

3:30 p.m. Tours of Research Laboratories

Tuesday, July 3

9:00 a.m. General Session
"School Facilities for Science Instruction"
"This Is Your NSTA"

10:30 a.m. Concurrent Sessions—Elementary and Secondary
"Science Equipment and Experiences for the Elementary Grades"
"Science Experiences for the Gifted—What Is Our Responsibility?"

1:30 p.m. Concurrent Sessions

"Here's How I Do It"	Demonstrations
Elementary Science	Biological Science
General Science	Physical Science

NSTA on President's Committee

President Eisenhower has established a new National Committee for the Development of Scientists and Engineers. The National Science Teachers Association is one of seventeen organizations invited to have representation on the committee. Each organization will be represented by its president; thus NSTA's representative through July 1 will be Dr. Robert Stollberg and he will then be succeeded for one year by Dr. John S. Richardson.

In pointing out that American technical superiority "is now seriously threatened by those who use science for aggression and conquest," the President also recognized that "although the Government has a responsibility for increasing the supply and improving the quality of our technological personnel, the basic responsibility for solution of the problem lies in the concerted action of citizens and citizens' groups organized to act effectively." The seventeen organizations with membership on the committee are as follows:

American Association for the Advancement of Science
American Association of Land Grant Colleges and State Universities
American Council of Learned Societies
American Council on Education
American Federation of Labor-Congress of Industrial Organizations
American Society for Engineering Education
Council of Chief State School Officers
Engineers Joint Council
Governors' Conference, Council of State Governments
National Academy of Sciences
National Association of Manufacturers
National Association of Secondary School Principals
National Education Association
National Science Teachers Association
Social Science Research Council
United States Chamber of Commerce
United States Conference of Mayors

Rounding out a nineteen-man committee are the appointed Chairman, Dr. Howard L. Bevis, President of Ohio State University, and Vice-Chairman, Dr. Eric A. Walker, Dean of the Pennsylvania State University

Engineering and Architectural College. Executive Secretary for NCDSE will be Robert L. Clark, formerly with the Office of Defense Mobilization. Housing and staff services for the Committee will be provided by the National Science Foundation.

Election Results

Soon after desert had been served at the Annual Banquet during the Fourth National Convention of NSTA, some 600 persons sat with bated breath listening to the report of election results as given by Elections Committee chairman Ned Bryan. By the votes of more than 1500 NSTA members who participated in the mail balloting, the following were chosen to provide service and leadership to the Association through the offices and during the years indicated for each.

President-elect (1956-57): Glenn O. Blough, University of Maryland, College Park

Secretary (1956-57): Gertrude W. Cavins, San Jose State College, California

Treasurer (1956-57): Richard H. Lape, Amherst Central High School, Snyder, New York

Director, Region II (1956-58): Herbert H. Reichard, Allentown High School, Pennsylvania

Alternate Director, Region II (1956-58): Dorothy E. Alfke, Pennsylvania State University, University Park

Director, Region IV (1956-58): Ernest E. Snyder, State Teachers College, Florence, Alabama

Alternate Director, Region IV (1956-58): John A. Manning, Natchitoches High School, Louisiana

Director, Region VI (1956-58): Henry E. Goebel, Irving Junior High School, Lincoln, Nebraska

Alternate Director, Region VI (1956-58): Gertrude M. Olson, Great Falls High School, Montana

Director, Region VIII (1956-58): Edward M. Gurr, South Mountain High School, Phoenix, Arizona

Alternate Director, Region VIII (1956-58): Robert A. Rice, Berkeley High School, California

Congratulations and welcome to these new members of the NSTA Board of Directors. As they assume office July 1, they will join with "carry-over" Board members in furthering the important work of NSTA. A complete roster of the 1956-57 Executive Committee and Board of Directors will be given in the September issue of *TST*.

NSF Grant for Physics Study

The National Science Foundation has just announced a grant of $3450 to support the work of a Committee on Teaching Materials for High School Physics. This Committee was recommended last year at the Greenbrier Conference on the Production of Physicists and has been appointed jointly by the American Institute of Physics, the American Association of Physics Teachers, and the National Science Teachers Association. NSTA's representatives on the Committee are: Mr. Fred T. Pregger, State Teachers College, Trenton, New Jersey; Dr. Harold S. Spielman, City College of New York; Mr. Glenn A. Crumb, Wichita High School, Kansas; Mr. Merton Hasse, University of South Dakota, Vermillion; and Mr. Dave Pangburn, Park Ridge High School, Park Ridge, New Jersey.

Representing AIP are: Dr. George S. Harrison, Massachusetts Institute of Technology, and Dr. Frederick Seitz, American Institute of Physics, New York City. The American Association of Physics Teachers is represented by Dr. Winston Cram, Kansas State Teachers College, Emporia, and Dr. Walter C. Michels, Bryn Mawr College, Pennsylvania.

Mr. Pregger is chairman of the Committee. The grant will be administered by AIP.

NSTA Life Members

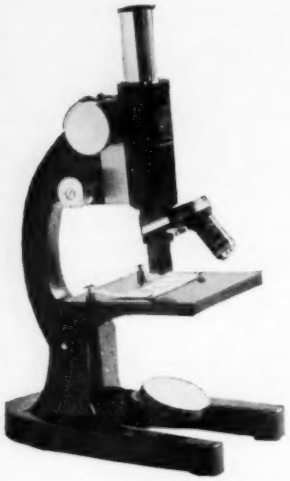
The NSTA membership list of 9000 now includes 192 Life Members. As an important link in the NSTA chain, these members are among the most vigorous in supporting our professional endeavors. Since the last listing in the November, 1955, issue of *TST*, the following have become Life Members:

ALTEMUS, ELAINE, Beaver Dam, Wisconsin
AYLESWORTH, THOMAS G., Battle Creek, Michigan
BAKER, JAMES, Sterling, Illinois
BARNARD, J. DARRELL, New York City
DOE, PAUL R., Hyde Park, New York
DONAHUE, B. MICHAEL, Carmel, California
DONALDSON, ROBERT R., Plattsburgh, New York
ELMER, LLOYD F., Edgewood, Maryland
FAST, KENNETH V., Webster Groves, Missouri
GAWLEY, IRWIN H., JR., Upper Montclair, New Jersey
GOULD, HENRY, Brockport, New York
HENDERSON, J. DONALD, Grand Forks, North Dakota
JOHNSON, LEONARD B., Milwaukee, Wisconsin
KIRKPATRICK, V. E., Edison, Nebraska
MAEHLING, LEON H., Yuma, Arizona
MASATSUGU, TERUO, Honolulu, Hawaii
MCBEE, MELVIN D., Deer Park, Texas
MCNEAL, DANIEL L., Urbana, Ohio
PAYNE, NELSON A., New York City
PETERSOHN, RICHARD L., Center Moriches, New York
ROSS, ELDRED L., Walden, New York
RUNKLE, RONALD C., Cleveland, Ohio
SHUTTS, J. HERVEY, Minneapolis, Minnesota
SIMENDINGER, ELIZABETH A., Baldwin, New York
SIMMONS, MAITLAND P., Irvington, New Jersey
SISTER M. VICTORIA, O. P., San Francisco, California
SYLVESTER, RAYMOND M., Chicago, Illinois
TOWNSEND, MARGARET E., Lamberton, Minnesota
TRYON, DOROTHY T., Detroit, Michigan
VESSEL, MATTHEW F., San Jose, California
VORDENBERG, KENNETH E., Cincinnati, Ohio
WILLIAMSON, E. C., Souderton, Pennsylvania
ZINKE, CLIFFORD C., Denver, Colorado

STUDENT MICROSCOPES

GRAF APSCO CHICAGO U.S.A.

by *Graf-Apsco*



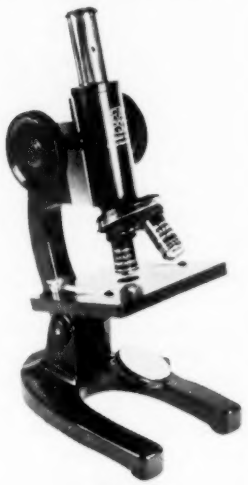
Model GB2

GENERAL BIOLOGY MODEL

This instrument has:
A FULL fine adjustment
All METAL coarse adjustment rack and pinion
Plano-concave mirror
STANDARD 16mm and 4 mm objectives
Mirror specially mounted so it cannot fall out.
Hughenian ocular 10x
Achromatic objectives: 16mm (10x) and 4 mm (44x)
Disc d aphragm
Price: $118.00 (we pay transportation)
Less 10% on 5 or more

ELEMENTARY BIOLOGY MODEL

This instrument equipped:
Same as above but without fine adjustment.
By using large buttons we have retarded the course adjustment action to insure easy focusing without a fine adjustment.
Price: $97.50 Less 10% on 5 or more



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Old microscopes accepted in trade.

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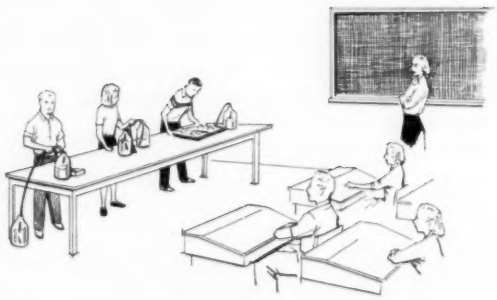
Operating Models for Introductory Science Classes

Soil and water kits make clear two of America's major problems.

Miniature pumps are helpful in teaching the principles of air and water pressure.

A model water treatment plant enables students to use their elementary knowledge of chemistry.

These models and others illustrate many applications of science principles and relate science to the children's everyday environment



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Students will clearly understand science principles after performing the many experiments described in the manual accompanying each kit.

Comprehensive Teacher's Manual

Written by Olive Mayer, professional engineer, in collaboration with Dr. Paul DeH. Hurd, professor of science education at Stanford University.

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product design

FSA Activities

Summer Conference for Wisconsin High School Chemistry Teachers

The Future Scientists of America Foundation is cooperating with Lawrence College, the Institute of Paper Chemistry, and the Marathon Corporation in conducting a conference for Wisconsin High School Chemistry Teachers, August 20-31 at Lawrence College and the Institute of Paper Chemistry. The general purpose is to assist teachers in their efforts to make high school chemistry teaching more effective. Marathon Fellowships of $250 have been awarded to thirty teachers to enable them to participate. The Fellows will prepare "a report to the profession" which will be published in an issue of *TST* next fall.

Looking to the Future

On May 16, the members of the Foundation's Administrative Committee will take a look at what we have done, are doing, and should do in the year ahead. They need, and will be most happy to receive, your suggestions.

The current program of the Foundation features the following activities:

1. Recruitment of new science teachers.
2. Encouraging science-related industries to hire teachers during the summer months.
3. Helping university and other science research laboratories use teachers as summer research assistants.
4. Providing fellowships enabling teachers to explore new types of summer conferences.
5. Publishing a convenient bibliography of materials and services that are available for encouraging future scientists.
6. Providing awards for students who report their science project activities or design science teaching charts.
7. Conducting research on science student enrollment trends.
8. Exploring the need for and services to be performed by a new type of science student magazine or newsletter.
9. Publishing booklets and other aids to help high school students exploit the opportunities in project activities.

Correspondence and conversations we have had with other teachers suggest that the following activities are worthy of consideration:

1. New publications designed to (a) help teachers sponsor more students in creative science projects, (b) acquaint industrial and professional scientific groups with what others are doing in their aids to science education programs, and (c) help elementary teachers solve their science teaching problems.
2. An all-out research program to assay the value of science fairs and how their total potential can be exploited. The study could be extended to include the elementary school science exhibit or open-house.
3. Providing more opportunities for talented high school students to take part in summer science activities.
4. Publication of tests and scales for identifying and counseling science-minded students.
5. Basic research into the motivations of young people toward scientific and technical careers.
6. Developing achievement tests in high school chemistry and physics.

Roster of Sponsors

Contributions from the following firms toward the support of the 1956 program of the Foundation have been received since the listing in the March issue of *The Science Teacher*. Although we appreciate very much the support of each of our sponsors, we especially welcome those firms who are joining us for the first time. They are marked with an asterisk.

*Argus Cameras, Inc.
General Aniline and Film Corporation
Monsanto Chemical Company
The Procter and Gamble Company
Standard Oil Company of California
Standard Oil Foundation (Indiana), Inc.
*United States Steel Corporation

Tomorrow's Scientists

In preparing *Tomorrow's Scientists*, we have tried to feature the methods most often used by today's and tomorrow's creative and inventive scientists. A second goal has been to illustrate the science careers that await young people.

Watch for the fourth exploratory issue of this new science student publication. Let us know if it should be continued. To date, 146 teachers have promised 1803 subscriptions for 1956-57.

NEW ANGLE IN DEMONSTRATION TEACHING

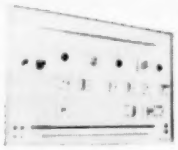
VERTICAL ATTITUDE

- - - - Afforded by famous

ELECTRONICS EDUCATOR

—Now Used in 15 States—

For over five years the Dumville EE trainers have afforded the teacher a "WORKING BLACKBOARD" approach for teaching electricity and electronics. Instead of the conventional blackboard schematic, with a little practice, the teacher can actually build complex circuits in one class period in full view. The student may duplicate lecture demonstrations with student model at his own class desk.



Demonstrator

FAMOUS EE KITS - -

NEW—Model S1114—Complete Special Trainer for limited budgets—Teaches electronics PLUS BASIC ELECTRICITY—with tubes, 5" coil for magnetic experiments, 30" x 48" oak framed board. Builds full 5 tube AC-DC Radio.....$80

Student Model

NEW—S2004—IDEAL TAKE-HOME PROJECT—Complete picture-frame radio-phono. Student goes through main basic steps in electronics and has a "naked" circuit visible daily at home after construction (patents protected). With tubes.....$35

MILITARY MODEL 1111—Beautiful oak cabinet w. 3 drawers. 150 mil supply.....$300

SUPPLEMENTARY MODELS at small cost—Kits 1112 through 1117—now available as follows: Advanced Electronics—Oscilloscope—Computers Control Circuits—Geiger Counter—Transmitters

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BIG Wall Chart—24" x 34"—AC-DC Superheterodyne Schematic. Useful in any science class.....$1.00

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Putting Animals in Groups

13 minutes *16mm Sound* *Color*

Introduces children to the idea that they can classify animals by observing their structures. Distinctive characteristics of mammals, birds, reptiles, amphibians, fishes and insects are presented in this order. The film ends with a review and summary that ties together the essential ideas. . . . The scientific vocabulary is kept to a minimum; the only technical words are those in quite common use in books and other printed material used in the elementary school. Common animals are used to illustrate the simple classifications. Frequent questions are included in the narration to help in the teaching. . . .

Educational Consultants: Dr. Glenn O. Blough, Associate Professor of Education at the University of Maryland, and Dr. Karl P. Schmidt, Chief Curator of Zoology, Chicago Natural History Museum.

To borrow or rent prints apply to your usual film source. To purchase apply to

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Special Pre-Publication Offer

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SCIENCE TEACHING THROUGH PROBLEM SOLVING

This is the title of a 64-page volume to be published in September, 1956. It will contain a *full report* of the Fourth National Convention of the National Science Teachers Association. Texts of major addresses, summaries of panels and symposia, reports of the discussion groups, and other convention program items will be included.

The extensive treatment of "Problem Solving: How We Learn"—the convention theme—will be an invaluable reference help for all teachers of science in

Elementary Schools
Junior High Schools
Senior High Schools
Teacher Education in Science.

Publication price will be $2.00. But, if ordered before July 1, 1956, the price will be only $1.00. All pre-publication orders must be accompanied by payment. Order from and make checks payable to the National Science Teachers Association.

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Book Reviews

MONKEYS. Herbert S. Zim. 64 pp. $2.00. William Morrow and Company, Inc., New York. 1955.

Monkeys is another of the many pleasant books on subjects of interest to children, written by Dr. Zim in the last few years. Although directed at children at the elementary level, older children and adults will enjoy reading it. It covers the subject thoroughly, accurately and in a smooth flowing manner.

The subject is introduced by an explanation of just what a monkey is, who his relatives are, and how many different kinds of monkeys there are on the earth. Primates in general are carefully discussed. Then the most common types of monkeys familiar to most children are described in more detail. Habits, ranges, peculiarities, and sidelights add interest to each species considered.

By the time a child reads halfway through the book, sufficient interest has been aroused to make any child want a monkey as a household pet.

Dr. Zim skillfully solves this problem for parents by emphasizing the many problems of keeping a monkey in the home. In the event a child does acquire one, general directions are given for proper care and handling of the animal.

Each page is illustrated with realistic drawings that add much to the text. Teachers and parents might do well to read this book before visiting the zoo or studying the subject in class. It would be a valuable addition to any school library or that of a child interested in animals.

JOHN D. WOOLEVER
Mumford High School
Detroit Michigan

EARTH SCIENCE. Samuel N. Namowitz and Donald B. Stone. 401 pp. $3.96. D. Van Nostrand Company, Inc., Princeton, New Jersey. 1953.

Teachers of earth science who have been searching for a text which is satisfactory for class use will be pleased with this volume. It will undoubtedly prove very valuable as a reference work, if class adoption, at present, is not possible. The topics have been presented adequately, not only in the sense that the material conforms with the requirements of the Education Departments of the various states but also for intelligent presentation to the students. Some instructors may feel that much more subject matter has been included than can be covered, with justice, in a year's time and that the content is rather difficult. However, on examination, the majority of the teachers will discover that the concepts, by a judicious selection, could be adapted easily to the needs of the average class. One very good characteristic of this text is that it contains excellent supplementary materials which will prove of great value to those superior students who have a special interest in earth science.

The language is simple, accurate, and geared to the comprehension of the high school population. The illustrations and the line drawings are numerous and have been carefully chosen. Several helpful self-examination features are included at the end of each chapter. Some examples of these aids are "Have you learned this?", special topic questions, general questions, suggested student activities, supplementary topics and a bibliography for more intensive reading.

The text is developed around five units: 1. The Earth and Its Land Forms (Geology); 2. The Earth and the Universe (Astronomy); 3. The Earth and the Atmosphere (Meteorology); this unit should prove of great benefit to those students anticipating pre-flight education. 4. The Earth and the Oceans ('Science of the Seas'). 5. The Earth and Its Climates (various factors influencing climate).

While the matter in the Appendix may not be required in many States, it contains much interesting material which serves to introduce the students to historical geology. This matter, if time permits, can be readily integrated with the required content. If, in class presentation, the material of the text should be 'watered down' then it will be a disaster for all the careful research of the authors will be in vain. Available along with the text, is a teacher's manual which contains many desirable teaching suggestions which will prove valuable not only to the neophytes in the teaching profession but also the veteran instructor who is ready to profit by having on hand the bibliography and sources of recent audio-visual aids compiled by the authors.

HENRY F. WHITE
Fordham University
New York, New York

EXPLORING SCIENCE, BOOK FIVE and EXPLORING SCIENCE, BOOK SIX. Walter A. Thurber. (Book Five: 320 pp., $2.24; Book Six: 352 pp., $2.40.) Allyn and Bacon, Inc., Boston, Massachusetts. 1955.

These two books are a part of a six-year science series. They represent another fine set of books which may be used as a basic text or as an additional reference in the classroom or library.

Each teacher's edition begins with an overview of a good science program. This is followed by science definitions and detailed suggestions for teaching each book. A complete bibliography is listed for each unit. The teacher's guide is particularly helpful to a person who is reluctant to teach science, but it is also flexible and challenging enough for the experienced teacher whose "first love" is science.

Children are not handicapped by the mechanics of reading. Sentences are simple, paragraphs are brief, and the vocabulary is controlled.

The contents of the books are planned to give continuity to science teaching, as well as to expand science concepts on the various levels. Book Five and Book Six include fourteen areas in each volume. They present such topics as, "Insects That Work Together," "Electric Circuits," "Making Work Easier," and "How Airplanes Fly."

The science material is presented in an interesting and accurate way. In many cases, illustrations are very colorful. Drawings and pictures are helpful in further presenting and explaining important information discussed in the context.

FLORENCE E. LEARZAF
Pittsburgh Public Schools
Pittsburgh, Pennsylvania

TWO EARS OF CORN, TWO BLADES OF GRASS. D. H. Killeffer. 139 pp. $4.00. D. Van Nostrand Company, Inc., New York. 1955.

In these days of concern and pessimism over the future of our welfare and of our resources, this well-written, interesting and concise book goes a long way toward dispelling many of our fears. In the Introduction the author states, "The gist of this book can thus be easily stated: universal peace can be easily and surely realized by applying technology and science through human cooperation and collaboration to solve the basic human problems of nutrition, health, and resources."

Through mastery of chemical synthesis our abundant raw materials can be converted into all the food, clothing, and fuels, needed by the increasing populations of the world. Chemistry likewise is improving our nutrition and health and prolonging life. "Quantity production of food at high efficiency is still a novel idea, and its effect on populations has barely been suggested in all the world's history. But it seems quite clear that the best methods of agriculture and of food preservation and distribution now known in the United States could be practiced in other parts of the world to feed tremendous numbers of hungry people."

Foodstuffs can be grown without fields if necessary, atomic fission removes the major concern for power and fuel, new technologies will utilize inexhaustible low grade iron, aluminum, and magnesium deposits for all imaginable structural needs according to Dr. Killeffer.

An ever increasing number of men and women with trained minds are needed to develop and employ the technology to cope with the problems of the future.

Seemingly our scientists have the answer to our problems of survival through technology but we need the *human technology* necessary *now* to apply our knowledge toward elimination of famine, want, disease, envy, and covetousness as causes of aggressive war. Can we make our knowledge of science lead us to peace?

This book should generate much challenging discussion in science classroms throughout the country.

RICHARD L. WEAVER
University of Michigan
Ann Arbor, Michigan

SEASHORES, A GOLDEN NATURE GUIDE. Herbert S. Zim and Lester Ingle. Illustrated by Dorothea and Sy Barlowe. 160 pp. $1.00 (paperbound), $1.95 (clothbound). Simon and Schuster. New York. 1955.

This book is an informative guide to shells, sea plants, shore birds, and other natural features of American coasts. Nearly five hundred marine subjects are pictured in color. Unlike most guides there is emphasis upon the interrelations among the living things and their physical environment. Not only can one find a name for a creature but one can also gain an idea of how the creature lives and where it would be found. By a simple pictured key many of the common seashore plants and animals can be quickly associated with a particular group. Representatives of each of these particular groups are in turn pictured, named by common names, and described. Scientific names are available at the end of the book. There is a bibliography. This is the kind of guide children as well as adults will use frequently.

N. E. BINGHAM
University of Florida
Gainesville, Florida

Books Received

THE MIRACLE OF LIGHT AND POWER. Captain Burr W. Leyson. 186 pp. $3.50. E. P. Dutton & Company, Inc., New York. 1955.

The complete story of how electricity and gas, and also steam for heat and power, are produced and distributed to the consumer by a great modern public service organization.

IMAGINATION'S OTHER PLACE. Compiled by Helen Plotz. 200 pp. $3.50. Thomas Y. Crowell Company, New York. 1955.

A collection of poems of science and mathematics ranging from the ancient Hebrew poets to the moderns and from the serious to the humorous.

YOU AND TV. Robert Stollberg. 56 pp. Science Research Associates, Inc., Chicago. 1955.

A new addition to the Modern World of Science Series of SRA which will answer questions you may have about how the picture is formed on your television set, how a television camera works, how sight and sound travel from the studio to you, what happens inside your television set, and how television cameras are used in operating rooms.

THE COMPLETE BOOK OF SPACE TRAVEL. Albro Gaul. Illustrated by Virgil Finlay. 160 pp. $4.95. The World Publishing Company, Cleveland. 1956.

A combined handbook and elementary text for the prospective space-voyager presenting a basic introduction to the problems and facts of space travel.

WHAT IS SCIENCE? James R. Newman. 494 pp. $4.95. Simon and Schuster, Publishers, New York. 1955.

A collection of discussions, specifically written for this volume, in which 12 eminent scientists and philosophers explain their various fields to the layman.

EXPERIMENTAL PLANES: SUBSONIC AND SUPERSONIC. R. Frank, Jr. 146 pp. $2.50. Thomas Y. Crowell Company, New York. 1955.

The story of pioneers and pioneering in flight laboratories covering topics ranging from the mechanical difficulties of wing design, stabilization, and speed to the human problems of pilot reaction to speed, temperature, and gravity. Fifteen different aircraft are described.

GUIDED MISSILES IN WAR AND PEACE. Nels A. Parson, Jr. 161 pp. $3.50. Harvard University Press, Cambridge, Massachusetts. 1956.

A survey of guided missiles relating why they are needed, how they have come into being, how they fly, how they are guided, and how they are powered. Illustrated with simple diagrams and photographs.

ALL ABOUT BIRDS. Robert S. Lemmon. Illustrated by Fritz Kredel. 142 pp. $1.95. Random House, New York. 1955.

An addition to the All About Series presenting an overall story of birds to show their similarities and differences, their amazing habits and achievements. The author gives suggestions as to how to identify specific birds, study them as a scientist, and make friends with them as a neighbor.

ALL ABOUT OUR CHANGING ROCKS. Anne Terry White. 137 pp. $1.95. Random House, New York. 1955.

The All About Series book which tells of the vast changes that have produced the different kinds of rocks and how to identify the rocks we see around us.

Audio-Visual REVIEWS

The audio-visual reviews for *The Science Teacher* are submitted by the Film Preview Committee which screens, evaluates, and recommends the curricular use of new films and filmstrips.

We wish to express our appreciation to Billings Kohnken, *Chairman*, and Minta Gaines, *Secretary*, of Englewood, Colorado, Junior High School; the subchairmen for primary, intermediate, junior high, and senior high school level films; and the other members of the committee who have served during the year.

—The Editor.

ANIMALS AND THEIR FOODS. 11 min. sound, 1955. $55 B & W, $100 Color. Coronet Instructional Films, Coronet Building, Chicago 1, Ill.

Recommendation: May be used on primary level in areas of science and language arts.

Content: The animals seen in this film are divided into three groups; those that eat plants; those that eat meat; and those that eat both plants and meat. The basic concept presented is that different animals are suited to eating different kinds of food, that wild animals must search for food, and that all animals need food to live and grow.

Evaluation: The commentary and photography are very good. The relationship between animals and their environment was consistent. Teacher's guide is available.

◊ ◊ ◊

ATOMIC METALLURGY. 12 min. sound, 1955. $55 B & W. Handel Film Corporation, 6926 Melrose Ave., Hollywood 38, Calif.

Recommendation: Junior and senior high school science area and with science clubs.

Content: The film shows the apparent reaction of radiation from molecular fission upon metals and metallic materials. The changes observed through scientific testing and microscopic examination are featured.

Evaluation: The organization of the film and the commentary add to the value of the film. This film is one of a series being produced through the technical assistance of the Atomic Energy Commission. It stresses scientific skills and attitudes.

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MAN'S USE OF ATOMIC POWER. 48-frame filmstrip, 1950. $6.50 B & W. Popular Science, 353 Fourth Ave., New York 10, N. Y.

Recommendation: Junior high school science area.

Content: The film strip traces the history of man's use of power, muscle, steam, water, and electrical energy; it explains the concept of the atom and the possible future use of atomic power for constructive use in the fields of science, agriculture, medicine, and public health.

Evaluation: Fair organization. There is more factual information than can be handled with one setting. Captions and photography are good. Filmstrip should stimulate interest and reading.

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ENERGY FROM THE SUN. 11 min., sound, 1955. $50 B & W. Encyclopedia Britannica Films, 1150 Wilmette Ave., Wilmette, Ill.

Recommendation: Junior and senior high school science area.

Content: The film begins with an exploratory visit to the sun by means of unique, telescopic, stop-motion photography made at the High Altitude Observatory, Climax, Colorado. Scenes made over a number of years reveal the violent eruptions at or near the surface of the sun—eruptions that eject solar matter millions of miles into the universe. On the surface of the earth the energy from the sun is transformed into other kinds of energy. The film illustrates in simplest terms how the fusion of hydrogen nuclei forms helium nuclei and how some of the mass, which appears to be lost, is actually converted into large amounts of energy.

Evaluation: This is an excellent film presenting a very graphic picture of solar energy. It stresses the transfer of solar energy into potential energy in the form of water power. In a demonstration of photosynthesis, animated drawings reveal the changes of radiant energy in the presence of chlorophyll which is found in all green plants. After showing how sugar is stored in plant cells, the film describes the formation of coal and oil in underground deposits. The film also stresses the possibilities of utilizing solar energy directly.

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LIVING DESERT. Six, 48-frame Filmtrip Series, 1955. $36 Color. Encyclopedia Britannica Films, 1150 Wilmette Ave., Wilmette, Ill.

Recommendation: This series of filmstrips would be best adaptable for grades 5 through 7 in science and social science areas.

Content: In these filmstrips much of the atmosphere of Walt Disney's original academy award winning picture has been preserved. They integrate science and geography well. The portrayal of life on a seemingly empty expanse of sand and sparse vegetation reveals the amazing and tedious life of the creatures of the desert, their habitat, environment, and the tenacity of their survival. Titles are: GREAT AMERICAN DESERT, SURVIVAL IN THE DESERT, MAMMALS IN THE DESERT, SMALL CREATURES OF THE DESERT, and PLANT LIFE IN THE DESERT.

Evaluation: This is an excellent set of filmstrips. The photography and color add to the realism of the scenery and to the plant and animal life found in the desert. They will stimulate interest and provide facts. A teacher's manual accompanies these filmstrips.

Activities of NSTA AFFILIATES

► "The Science Program in Sequence—A Perspective" was the theme of the CONNECTICUT SCIENCE TEACHERS ASSOCIATION Annual Meeting on April 7. The program included an address on the elementary science program by Dr. Herman Schneider of the City College of New York. A one-day Science Teacher Institute will be held on May 5 at the Medical Research Laboratory in Ridgefield, Conn. The Institute, to be sponsored jointly by CSTA and NSTA, will be concerned with recent trends and developments in science. The proceedings of the First Connecticut Conference of the Teaching of Science have been made available to non-members at $1.00 a copy. For further information contact Mr. Howard Norris, President, CSTA, The Loomis School, Windsor, Conn.

► The NATIONAL ASSOCIATION FOR RESEARCH IN SCIENCE TEACHING held a meeting on April 21-23 in Chicago. The program included reports of research papers, a symposium on "Needed Research in Science Teaching at Various Academic Levels," and reviews of recently published literature in elementary, secondary, and college teaching.

► The NEW ENGLAND ASSOCIATION OF CHEMISTRY TEACHERS will hold its Eighteenth Summer Conference at the University of New Hampshire, August 20-25. Discussions are being planned on a variety of topics of both professional and general interest. Recreation programs will also be scheduled so that conferees may combine a vacation with attendance at the lectures.

► Last fall the OHIO SCIENCE EDUCATION ASSOCIATION voted to develop a bulletin to be sent periodically to their members. With issue Number 2 in the mail, the *OSEA Exchange Bulletin* is a going concern. In addition to keeping readers posted on current publications and events, the Bulletin provides a medium for exchange of science teachers' ideas. The OSEA has set aside $150 to stimulate the development of workshops in science. The purpose will be to bring together science teachers who are interested in keeping abreast of recent developments in science, and college and industrial experts who are available to provide such knowledge.

► The WEST VIRGINIA SCIENCE TEACHERS ASSOCIATION held a dinner meeting on April 19 at which Mr. Walter C. Gumbel spoke on "Education's Opportunities in a Resource-Use Program." Mr. Gumbel is Conservationist for the Monongahela Power Company and is the Editor of the *Journal of Soil and Water Conservation.*

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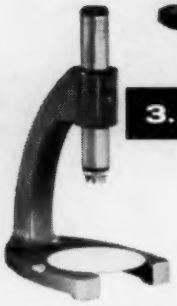

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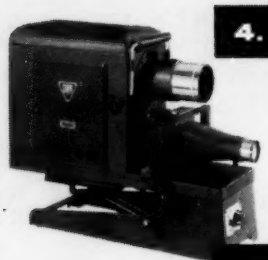

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